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The Effects of Ultrasonics on the Electrolytic Deposition of Metals Results of Investigations

Barrel Finishing
Fundamentals and Principles

Finishing Pointers

Bath Concentration Units

Science for Electroplaters

Treatment of Chromate Wastes

Contents Page 43



READ & PASS ON



# industry's general purpose



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The contract shop should find CLEPO 136-R mighty useful. Hardly knowing from day to day what cleaning problems will arise, that versatile all 'round cleaner, 136-R, is a good one to have handy. It can be used with all the commonly used metals for removing mineral oil, sulphurized oil, buffing compounds and common shop dirt. It's good for still and slusher-type tanks.

What is CLEPO 136-R? It's a blend of highly effective inorganic cleaners and an unusually effective combination of organic emulsifiers, wetting agents and detergents. It can be used over a wide range of concentrations and temperatures. It's fast-working.

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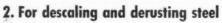
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## Here are 6 good methods for making easy jobs out of hard ones



#### 1. For precleaning in the plating shop

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Oakite Rustripper saves time by removing heat scale and rust in the same operation that removes oil. Alkaline pickling with Rustripper avoids hydrogen embrittlement, etching of machined surfaces and other disadvantages of acid pickling.



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1. "Some good things to know about Metal Cleaning"

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#### 4. For electrocleaning brass

over by plating racks.



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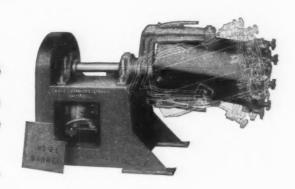
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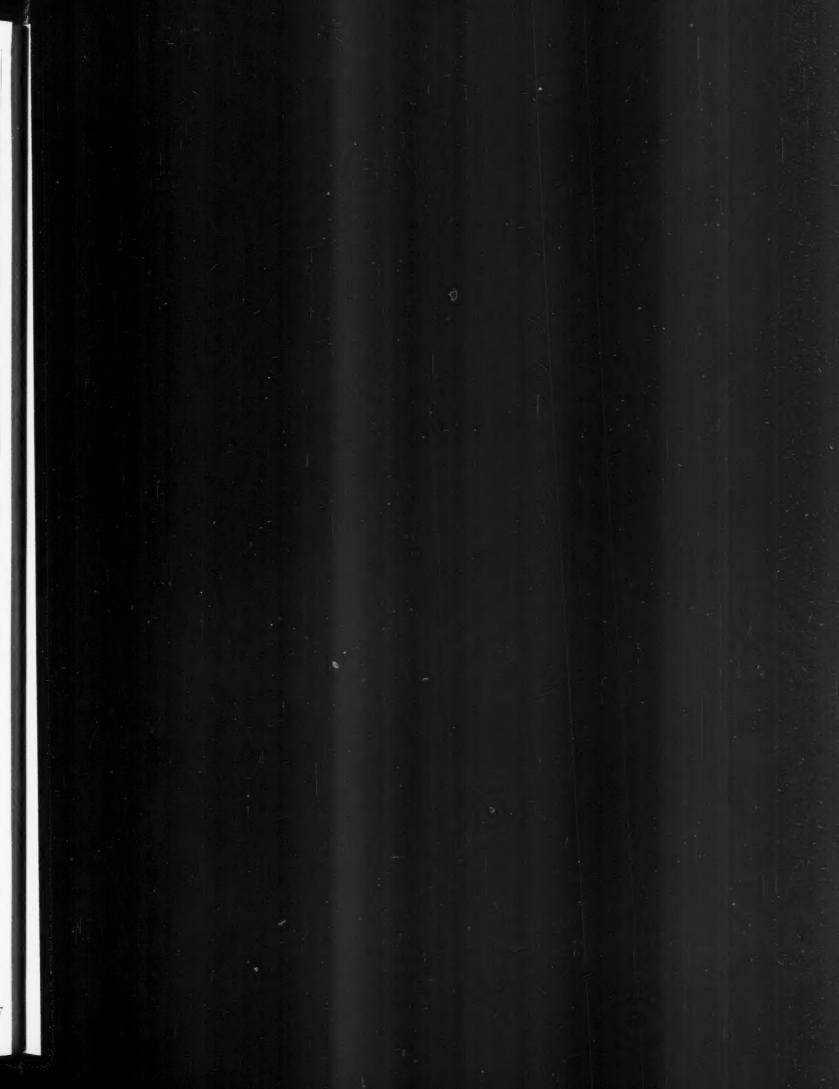
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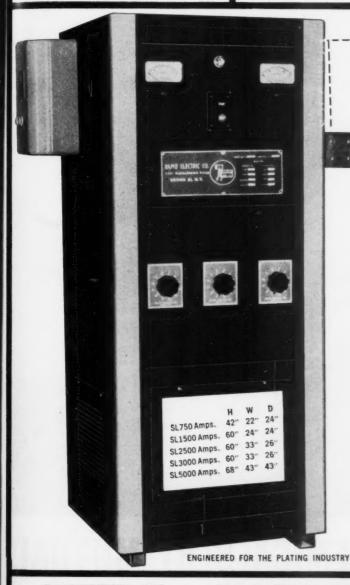
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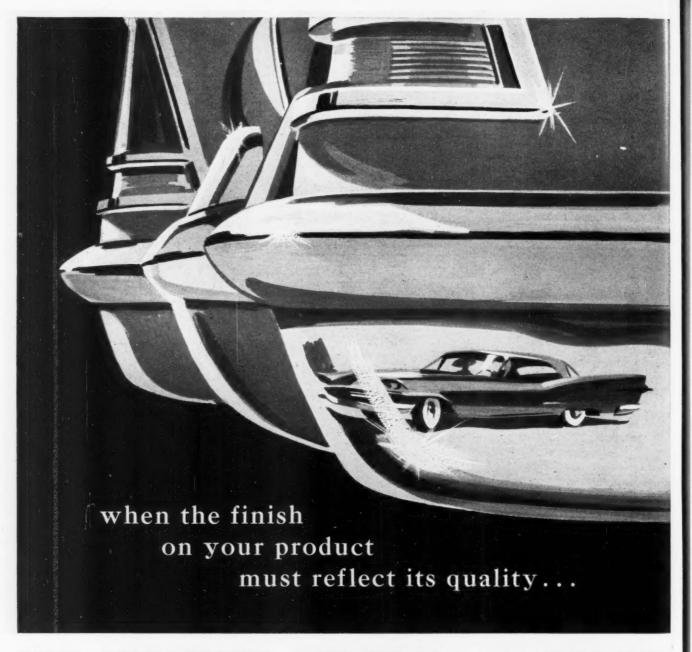
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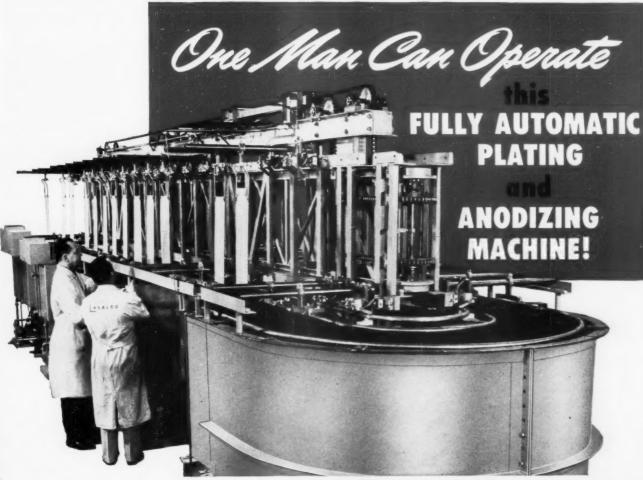
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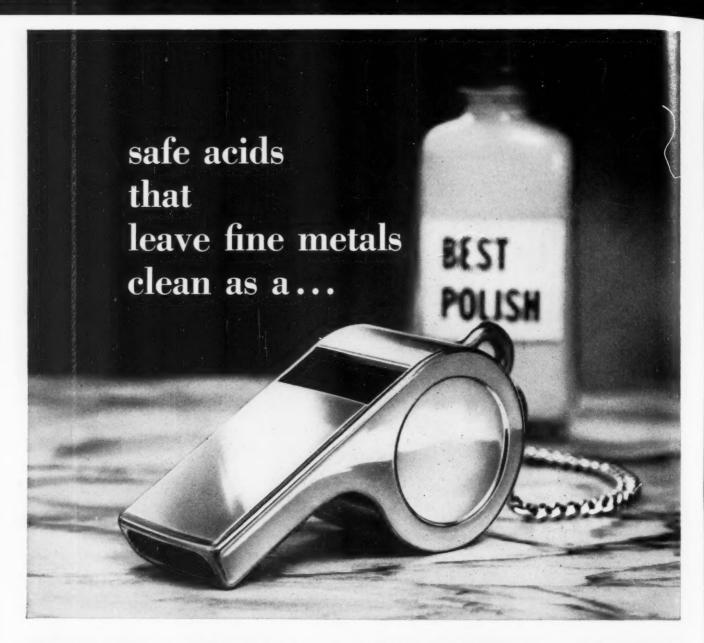
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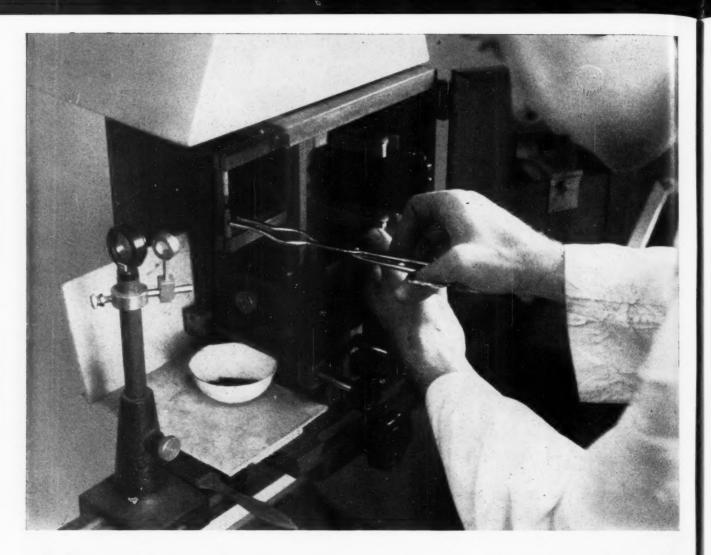
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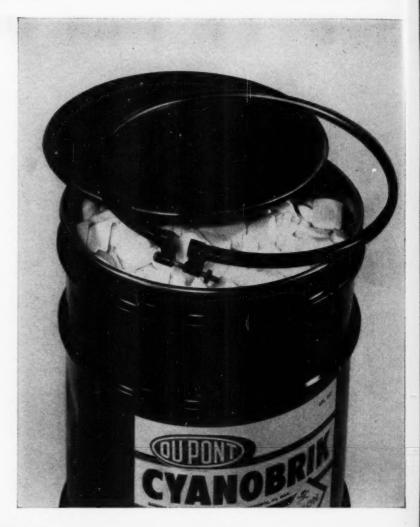
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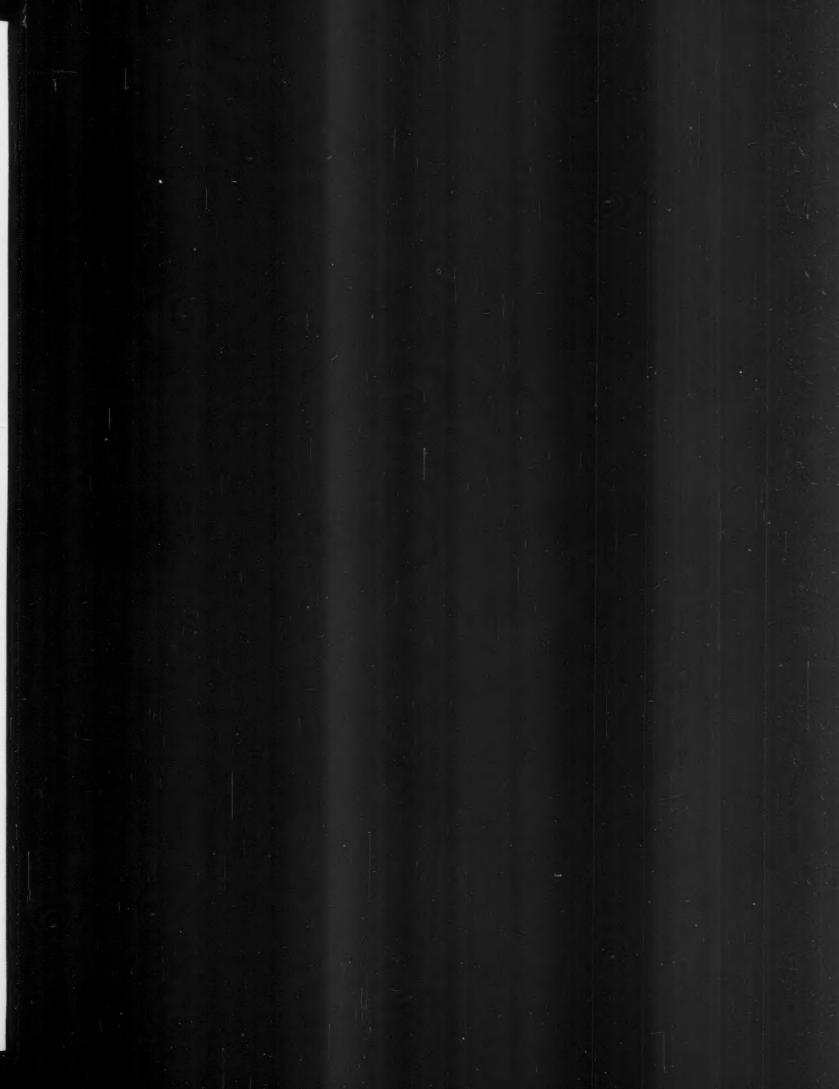
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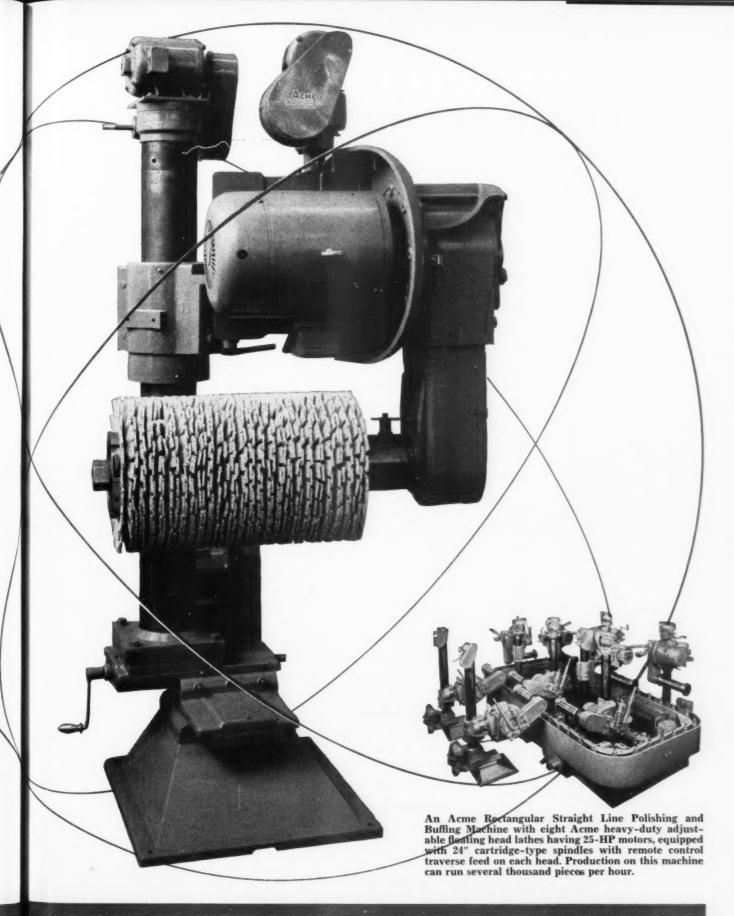
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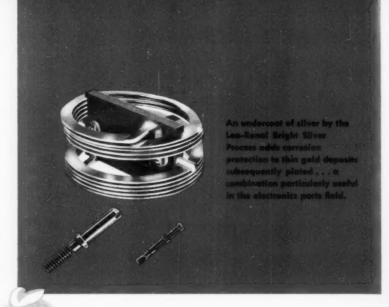




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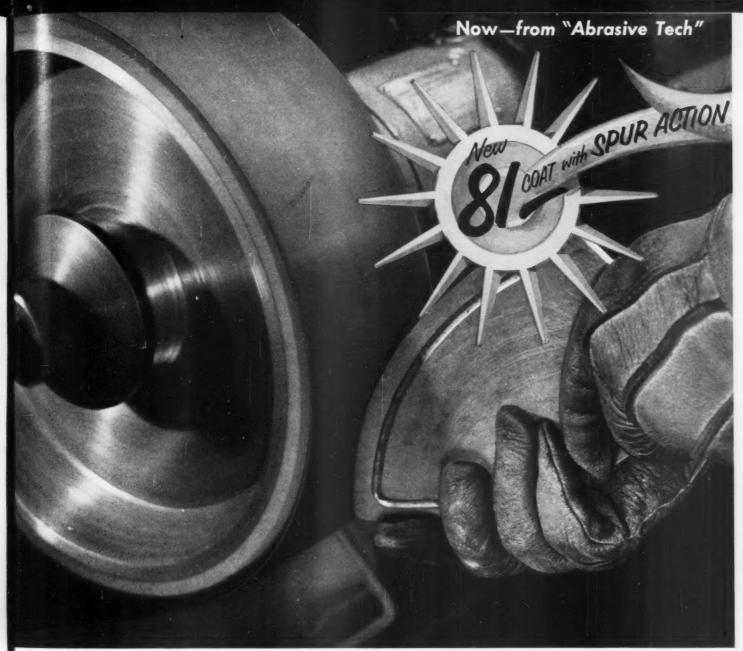


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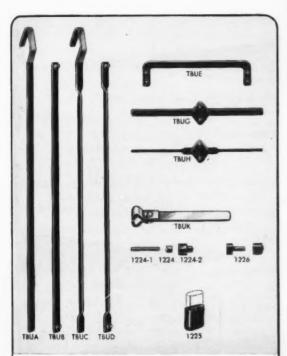
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# with Thinker Boy Plating Racks



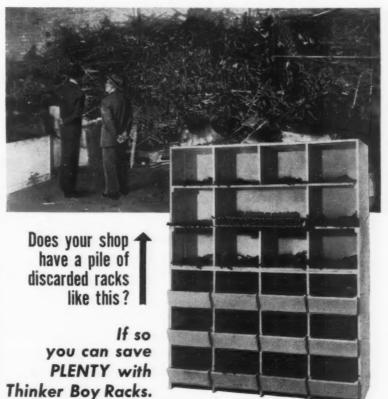
Thinker Boy — preformed rack sections — precoated with BELKE Universal Plastic and equipped with BELKE Vac-Seal Fittings. Assemble with a leakproof seal for quick, economical manufacture of the racks you need when you need them!

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TBUC	24, 30, 36"
TBUD	10, 12, 14, 16, 18, 20, 22, 24, 30, 36"
TBUE	6, 8, 10, 12, 14, 16, 18, 20, 22, 24"
TBUG	10, 12, 14, 16, 18, 20"
TBUH	10, 12, 14, 16, 18, 20"
TBUK	Attachable Handle-Clamps on cathode hook
1224	Tapered Stainless Steel Nut
1224-1	Stainless Steel Stud
1224-2	Plastic Cover Cap
1226	Plastic Plug for unused holes
1225	Boot-Used to cover cut end of sectional member

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Ask your BELKE Service Engineer or send for illustrated bulletin.





# Platers Like it! They Buy It! They Buy It Again!

The new economical Udylite Zero-Mist H.T. is proving to be a boon to chrome platers for it eliminates the troublesome mist and spray of chromium plating solutions. Its complete stability even under high temperature, and the low cost of charging a solution with Zero-Mist H.T. are two of the many advantages responsible for its ever widening acceptance.

Here are a few users' comments about the new Zero-Mist H.T.

"We are very enthusiastic about Zero-Mist H.T. Only four pellets per day are used. We have no ventilation whatever for the solution tank."

"Our laboratory sample of Zero-Mist H.T. worked so well we are ordering an additional 20 pounds."

"Operation of Zero-Mist H.T. has been excellent and we are pleased with its lower cost."

"Pleased with the fume suppression and lasting qualities of Zero-Mist H.T.

"Completely satisfied with H.T. type Zero-Mist. We are now using only ½ to 1 pound per week in our solution."

"We are very happy with Zero-Mist H.T. Right now we are using it in both full automatics with a total of 1,260 gallons of solution. One machine is transferring 140 times per hour-the other 160 times per hour with tremendous dragout on both machines. Working on a five day, twoshift a day week we are using 5 pounds of Zero-Mist H.T. every two weeks.

"The original charge of Zero-Mist H.T. in our 2,000 gallon chrome tank was on the basis of  $1\frac{1}{2}$  pounds per 1,000 gallons. We have now added 4 ounces after 60 hours of operation. The foam blanket is not as thick as it was originally but now it can be brought back to normal by adding slightly more make up. Anode bars show no chrome stains indicating to us complete suppression. Appearance of work indicates less dragout."

"By using Zero-Mist H.T. in all our chrome tanks we estimate we have saved over 22,000 lbs. of chromic acid compared to a like period before its

> "We are using an average of 5 oz. of Zero-Mist tablets per 12-hour shift. No ventilation of chrome tank. Very Pleased."

inexpensive II does the job! Try ZERO-MIST H.T. today!



WORLD'S LARGEST PLATING SUPPLIER

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# GET TRIPLE-ACTION I M M U R O L 190 US Pat OFF

# The SAFE, LOW COST METAL CLEANER and RUST PREVENTIVE that will do more jobs for you!

Non-flammable, non-toxic, odorless Immunol cleans, degreases and rustproofs metal in one, fast, easy operation. It is widely used as a bucket solvent in metalworking plants to remove cutting oils, drawing compounds, mill dirt, stains, etc. from metal and it can be used over and over again.

IMMUNOL is widely used for these other applications, too:

- AS AN ADDITIVE TO SOLUBLE OIL EMULSIONS

  IMMUNOL gives cooler work, better tool life, better finishes and additional rust protection
- AS A TEMPORARY "IN PLANT" RUST PREVENTIVE

  IMMUNOL immunizes against rust for a few days
  prior to subsequent operations
- TO REPLACE SOLVENT AND VAPOR DEGREASING

  IMMUNOL will be just as efficient as other solvents.

  It will prevent rust and operators will like it better since bad odors, skin irritations and the danger of fire will be eliminated

#### FOR TUMBLING METAL

IMMUNOL is used (1) before tumbling as a cold dip to remove oils (2) as a rust inhibitor in the barrel to stop rust when parts susceptible to rust are being cleaned (3) to replace soap as a cleaner (4) as a dip rinse and rust preventive immediately after tumbling

#### FOR MAGNETIC PARTICLE INSPECTION

IMMUNOL gives better definition of flaw than kerosene or mineral spirits, eliminates the fire hazard, is odorless and prevents rust

TEST IMMUNOL AT OUR EXPENSE Write for a free sample today.



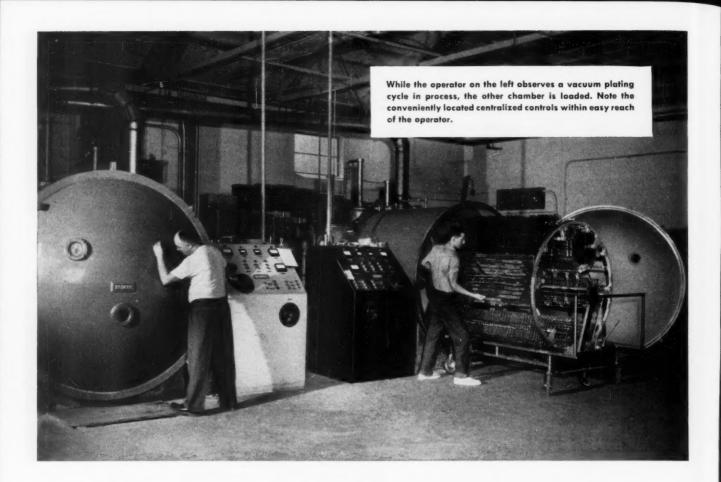
Manufacturers of STEELGARD,
HAMIKLEER, ACTIVOL, HAMICOTE

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Original Products and Processes Since 1936

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# Jayron Corp. credits continuous growth to Stokes vacuum plating equipment...

Jayron Corp., Leominster, Mass. is one of the country's largest custom vacuum platers. Hundreds of millions of parts are processed annually. Their own advanced engineering on auxiliary processes and techniques enables Jayron to meet all competition.

Mr. Boris Levine, President and Treasurer of Jayron, when asked about Stokes equipment in his plant, replied—"This is the third vacuum metallizer we have purchased from Stokes . . . each successive machine, with their new innovations, have always proved themselves in operation . . . we average three to four cycles per hour throughout the year, and the very growth of our company is due in part to the excellent equipment we operate."

Vacuum plating . . . often known as vacuum metallizing can impart a distinctive gold,

brass, copper or chrome finish, to conductive or non-conductive parts, at costs considerably lower than electroplating. Stokes vacuum metallizers feature interlocked centralized controls, making it easy for men to learn operating routines. Production to consistent quality standards can be met with minimum labor. The equipment is compact and self-contained . . . takes little floor space.

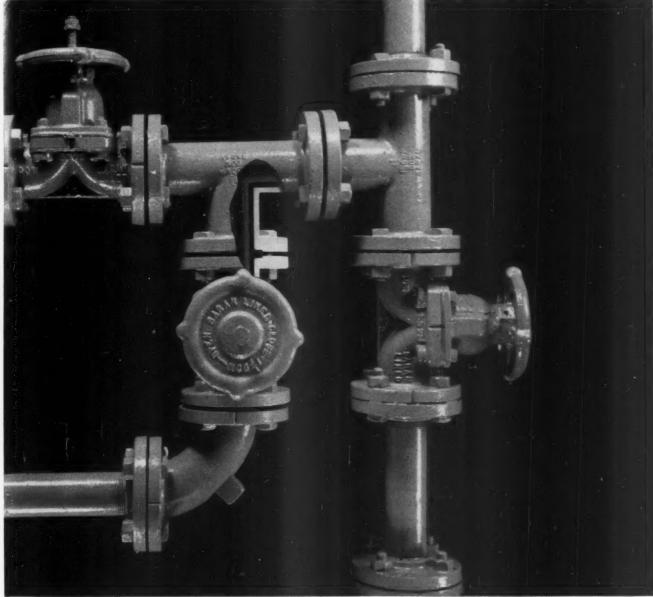
Investigate this low-cost method for finishing metals or plastics. Stokes can give you practical help in overall planning . . . determine plant layout as well as production techniques, rates and costs . . . select lacquer and auxiliary equipment . . . train your operators. Contact the nearest Stokes office, or write for additional data on Stokes Vacuum Metallizing equipment.

sar

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Vacuum Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.





Whatever the piping arrangement, liquid never touches metal in saran lined pipe, fittings or valves.

#### You can see why saran lined pipe cuts costly downtime

It's a rigid steel pipe lined with durable saran that corrosive liquids won't bother

.....

Now you can pipe commonly used acids, alkalies and other corrosive liquids without worrying about corrosion. With saran lined pipe, the liquid never touches metal—in the pipe, valves or fittings. Corrosion can't get a start—downtime troubles are eliminated.

Because it is two pipes in one, steel swaged onto saran, it has high strength. In fact, saran lined pipe will withstand working pressures up to 300 psi. Saran lined valves and fit-

tings are available for 150-psi and 300-psi working pressures.

You'll get other advantages when you use saran lined pipe. It's easy to fabricate and easy to install. Conventional pipe fitters' tools can be used for cutting and threading. And you can hang it as you would ordinary steel pipe.

If your operation can profit from long-lasting, corrosion-free piping, investigate saran lined pipe today. THE DOW CHEMICAL COMPANY, Midland, Michigan.

SARAN LINED PIPE COMPANY DEPT. SP1594C 2415 BURDETTE AVENUE FERNDALE 20, MICHIGAN

Please send me information on saran lined cipe, fittings and valves.						
Name	Title	Company				
Address	City	State				

YOU CAN DEPEND ON



# 15 WAYS TO BETTER METAL FINISHING

# A A HE CE CE

For fast removal of buffing compounds from all metal surfaces, Lustrebrite Liquids 35 and 58. For acid descaling and derusting of steel, Ahcoloid Cleaner #210, in convenient powder form.

For cleaning aluminum in power washers, Ahceleid Cleaners # 59-H-5 and 59-H-9, low foaming with high detergency.

For alkaline derusting of steel, Ahce Deruster # 11.

For smooth, even deburring of metal parts, Ahco Nuggets, fast heavy-cutting natural aluminum oxide media — sizes from 10-mesh to large 1½" or 2" available.

For coarse cutting of steel and iron parts, Ahce Cutting Compounds #17-D-4 and #17-D-7.

For low-cost bright burnishing of copper and brass, NEW Ahce Burnishing Compound P.

For low-cost burnishing of aluminum, NEW Lustrebrite Liquid # 50 AF.

For bright rolling of steel and iron surfaces, Ahco Burnishing Compound # 44.

For high-quality, low-cost buffing of all metals, Ahco Liquid Buffing Compounds.

For finishing all metals as well as plastics, Ahco Greaseless Compounds.

For producing bright, ductile nickel deposits in barrels, Ahco Barrel Brighteners PI and SI. (Two-brightener system.)

For phosphating steel, zinc, and other metal surfaces, Ahcophes Compounds.

For economical inhibiting of sulphuric or hydrochloric acid on steel and iron parts, Ahco Acid Inhibitor. For fast-drying, non-film-forming water displacing from all metals, Ahco Water Displacing Compound FD.

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Compounds.

All of these outstanding products are the result of the Ahco Laboratories' continuing research and development program.

AP OTHER ARIES MALL CO.

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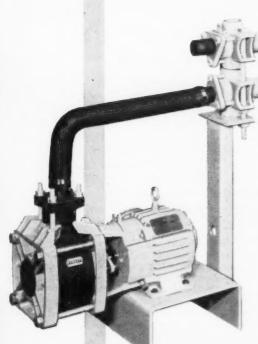
BE SEARCH WALL CHEMICAL CO.

Check blocks for FREE Bulletins you want ..... mail this ad to 10 Benedict St., Waterbury, Conn.



Want to heat and cool plating solutions economically?

# USE "KARBATE" BRAND IMPERVIOUS GRAPHITE



NEW! "KARBATE" Circulating Type Heat Transfer System — features proven "Karbate" Centrifugal Pump and "Karbate" Concentric Tube Heat Exchangers. Standard package units available immediately from stock provide from 4.1 to 35.2 square feet of heat transfer surface and circulating pump capacities from 20 to 100 gallons per minute.

Get information on these new units today!
Call your Local Distributor or write us at the address below

Take advantage of the proven corrosion resistance, low cost and long life of "Karbate" brand impervious graphite in your metal finishing processes. National Carbon manufactures a complete line of standard "Karbate"

impervious graphite, including centrifugal pumps, shell and tube and concentric tube heat exchangers, plate and bayonet immersion heaters, armored pipe, fittings and valves. Complete literature and proposals on request.



"KARBATE"

Plate Type

Heat Exchangers



"KARBATE"
Centrifugal
Pumps



Sturdy, compact, with up to 55 sq. ft. surface area per unit. Recommended particularly for plating, cleaning, and similar tanks. Available from stock in number of standard styles and sizes — widths to 19", lengths to 94". Catalog Section S6620.

Available in a variety of sizes and models for all corrosive services, "Karbate" impervious graphite standard centrifugal pumps combine high efficiency and wide capacity range with outstanding mechanical design. Catalog Section S7250.

The terms "Karbate", "National" and "Union Carbide" are registered trade-marks of Union Carbide Corporation

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Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco. In Canada: Union Carbide Canada Limited, Toronto.







#### TANKS

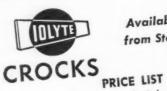
**Fabricated** to your Specifications

NO MOLDS NEEDED - Made any size, any shape, at no extra cost and no loss of delivery time.

UNIFORM DIMENSIONS - NO TAPERING - Dimensions are same at bottom and top . . . means larger capacities than tapered

FLANGES, DAMS, Etc. - Can be inexpensively equipped with flanged connection, holes, overflow dams, baffles, separations, etc. CHEMICALLY RESISTANT THROUGHOUT — Fabricated from iolyte sheet properly reinforced. This is a structural material . . . not a lining.

Write for literature, prices, and table of chemical resistance for lolyte tanks, crocks, ducts.





Gal. Outs. Diam. Hight. Cost Cost Cost Diam. 16" 24" 24.00 8 10" 12" 12" 24" 26.00 12 12" 14" 36" 50.00 24 14" 36" 50.00 12 16" 14" 29.00 12 16" 16" 14" 29.00 12 16" 16" 18" 36.00 12 16" 16" 18" 36.00 12 16" 36" 44.00 20 16" 36" 36" 40.00 30 16" 36" 40.00	26 30 40 40 58 78 64 95 125 88	18" 30" 18" 30" 18" 36" 22" 24" 22" 48" 28" 24" 28" 48" 33" 24" 33" 48" 36" 24"	48.00 59.00 65.00 60.00 84.00 108.00 110.00 149.00 110.00 200.00 119.00 225.00
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ANY DIMENSIONS ANY CURVES

ANY LENGTHS

iolyte has greater resistance to chemical attack than stainless, Monel, or aluminum. 1/5 the weight of steel, it is superior in tension, flexural, and compression strength. Unlike thermoplastics jolyte will not heat-distort below 350 deg.

Send drawings or prints for quotes and ask for literature giving chemical resistances.

Order from us or your distributor. Unless rated firm. payment with order. No COD's

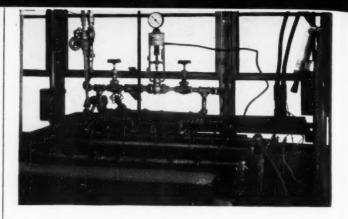
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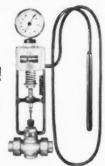
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#### PLATERS...

here's a sure way to cut operating costs!

#### Install AMERICAN TEMPERATURE REGULATORS



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Eliminate cloudy or rough deposits. Control deposit stress. Reduce rejects and consequent expensive reworking. Maintain constant color in alloy plating. Prevent breakdown of the solution. Maintain full throwing power. Stop overheating. Save steam.

All these advantages can be yours. Equip your metal finishing tanks with self-operated, automatic American Temperature Regulators. Temperatures are constantly maintained within required limits. You can be sure of continuously uniform, high-quality plating-no rejects. Where high-production conveyorized equipment is used, peak performance of the machinery is achieved.

American Temperature Regulators are available with an accurate temperature indicator as pictured here. Your men can tell immediately that required temperatures are being maintained. They can easily see and quickly reset the regulator when changing from one type of operation to another.

American Temperature Regulators are easy to select, install and maintain. No compressed air or electricity needed. Temperature adjustment and repeat setting take but a few seconds. Sizes:  $\frac{1}{2}$ " to  $\frac{1}{2}$ ". Temperature Ranges:  $\frac{90}{180}$ ° F. or  $\frac{135}{225}$ ° F. standard. System: Bulb and line of temperature system are covered with solutionresistant plastic, assuring long service life. Valve: Bronze body, single seated, with renewable stainless steel seat and disc. Screwed union ends. Write for complete details.



A product of

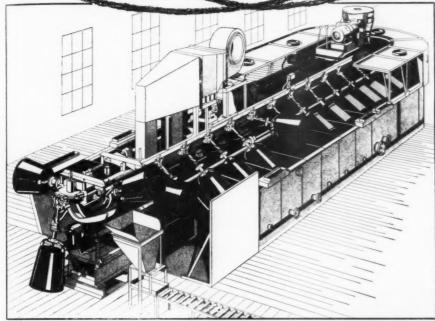
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YOUR INDUSTRIAL SUPPLY DISTRIBUTOR is as close as your telephone. Call him for experienced counsel, money-saving service and prompt delivery from local stocks.

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METAL FINISHING, September, 1957

# Barrel Plating by Stevens Really Cuts Costs



End View of Stevens Super "E" Automatic Barrel Plating Machine.

Since Stevens first introduced the Automatic Barrel machine scores of industries have enjoyed these operational advantages. Check them against your present operations.

MINIMUM LABOR REQUIRED — In most cases, one unskilled employee can operate the machine.

HANDLES THE COMPLETE CYCLE —Including cleaning, pickling, chromate treatments, plating, bright dip and drying.

**COMPLETELY AUTOMATIC** —No barrel lids to fasten and unfasten during automatic loading and unloading.

**BETTER HANDLING** — No mixing of parts. Becomes a part of a straight line production system.

NO HEALTH HAZARD — Occupational health hazards eliminated with ventilation of equipment.

UNIFORMITY OF PLATE — Accurate plating cycles timed to meet your requirements.

FITS ANY PLANT LOCATION —Does not need special buildings—Can be moved at any time. Low head room.

**DEPENDABLE** - Scores of machines in use. Machine design and construction constantly improved.

LOW INITIAL COSTS — For average operation lowest initial machine costs.

LOW MAINTENANCE COSTS — Proven over years of use and in varied operations.



Let a Stevens Sales Engineer show you how you can cut costs in your plating operation with a Stevens Automatic Barrel. Write us direct. Frederic B. Stevens, Inc., 1816-18th Street, Detroit 16, Michigan.

METAL FINISHING EQUIPMENT AND SUPPLIES, FROM CASTINGS OR STAMPINGS TO FINISHED PRODUCT

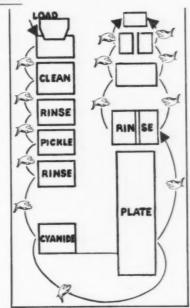
BRANCHES:

Buffalo • Indianapolis • New Haven
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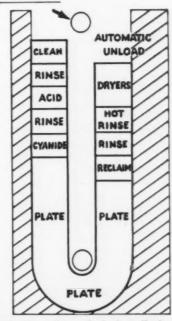
HOW AUTOMATIC
BARREL PLATING CAN
REDUCE YOUR HANDLING
AND BURDEN COSTS—

Compare this

Conventional Horizontal Barrel Line



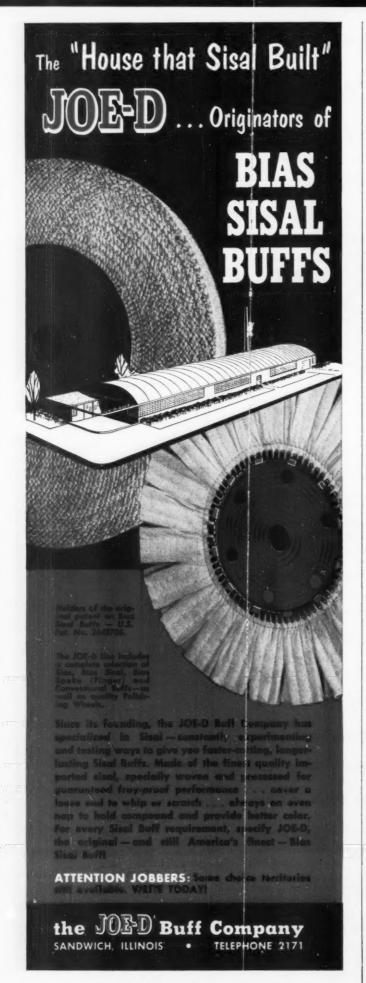
With this
Stevens Automatic Barrel
Installation



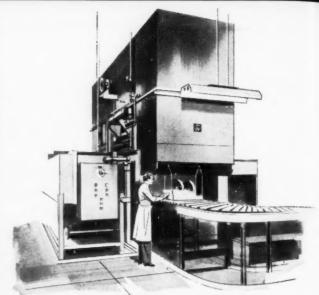
Production from both installations is the same.

Notice how many more handling steps (indicated by the illustrated hands) and manual load-unload operations (indicated by the arrows) are required for the manual set-up.

Notice, too, how much floor space (indicated by shaded area) is saved with a Stevens automatic installation. No manual operations required with automatic load and unload.



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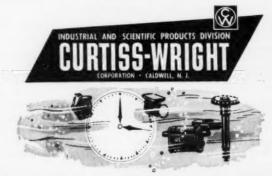
# Curtiss-Wright Ultrasonic Degreaser DB4-60 cleans hundreds of metal parts in minutes

Ultrasonics – the science of high frequency vibrations – is today revolutionizing cleaning techniques. Curtiss-Wright ultrasonic cleaning and degreasing equipment has developed to a point where it is now practical for all types of production parts. High precision instruments, hair-thin electronic components and mass produced parts are thoroughly cleaned in seconds.

Pictured above is the new Curtiss-Wright Degreaser DB4-60 which cleans and degreases 95% of the precision parts of a Curtiss-Wright Turbo-Compound aircraft engine prior to assembly. Where formerly this operation took hours, these parts are now cleaned in minutes — and cleaned more thoroughly.

The Curtiss-Wright line of standard and custom ultrasonic cleaning and degreasing units varies in size from 8" x 8" x 10" to as large an ultrasonic area as 38" x 66" x 36". Automatic conveying equipment and servo controls are utilized where required by production volume.

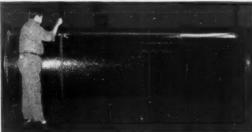
Discover how Curtiss-Wright cleaning and degreasing equipment can lower your costs and speed your operation. Our engineers are available to give prompt consideration to your problems.



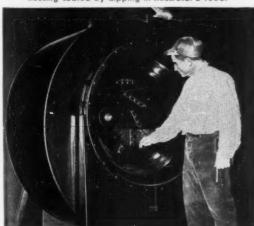
CANADIAN REPRESENTATIVE: CURTISS-WRIGHT OF CANADA, LIMITED, MONTREAL

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ABOVE: Large duct section coated by spraying with Miccrosol Spray S-2003. BELOW: Fan housing coated by dipping in Miccrosol E-1003.



Developed and manufactured by experienced platers and coaters

Developed originally as a coating for plating racks, Miccrosol E-1003 has all the desirable characteristics which make it an ideal coating for many other applications.

The chemical resistance of Miccrosol is unequalled in its field. Its toughness, abrasion resistance, resilience, and flexibility are unsurpassed. It's easy to apply in either a dip or spray formula. When necessary, it's easy to repair.

Year after year we build this quality into Miccrosol, improving it whenever possible and practicing every economy in its manufacture that does not compromise the excellence of the product.

This BALANCED QUALITY enables you to use Miccrosol profitably while assuring your customers of coating jobs that will prove superior in their performance.

\*Outstanding performance and value

For tanks, ducts, and other equipment



CHIGAN CHROME and Chemical Company

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### Leading metal cleaning formulators can tell you— Dow Alkali does make a difference!

The average user of metal cleaning compounds can easily see the difference in performance between a good cleaner and a poor one. However, it's not so easy to detect the difference between two cleaners that give nearly equal cleaning efficiency.

Yet, there often is a difference.

Leading formulators of metal cleaning compounds know that the ingredients they start with make a difference—an

important difference in cleaning efficiency. That's why they use Dow Sodium Orthosilicate and Dow Caustic Soda year in and year out. Experience has proved to them that these ingredients deliver the highest alkaline cleaning power they can buy at any price!

Ask your supplier of metal cleaning compounds about the important difference in formulations made with Dow Alkali. The DOW CHEMICAL COMPANY, Midland, Michigan, Department AL 611K-1.

YOU CAN DEPEND ON





CIBA

For Aluminum Oxanal® Fast Dyes



The story of aluminum is a classic in metallurgy. Now put to infinite uses, from foil wrappings to skyscraper panels, aluminum has inevitably and naturally turned to color. Through surface anodizing aluminum is dyed in practically all colors with inherent beauty and fastness. Outstanding for this purpose are the OXANAL FAST dyes of CIBA. Backed by CIBA's vast experience with dyes, they offer the best assurance of fine aluminum dyeing.

Whatever your interest in aluminum-

Remember that OXANAL FAST dyes keep color on the job!

CIBA Company Inc., 627 Greenwich Street, New York 14, N. Y.

## AUTOMATION comes to YOUR

## TANK LINES

Announcing: The most advanced development of automation engineering in metal finishing! Now a reality — perfected, patented, proven, practical.

> Converts your present tank lines into a super-flexible automatic plating machine.

#### FULLY AUTOMATIC

Eliminates manual operations, human errors. Eliminates electric hoists, and their maintenance. Saves thousands in manhours, equipment, and headaches. Perfect automation for all typical job shop operations. For multiple variety plating runs in same line.

#### FLEXIBLE

Adapts to your present tanks and superstructures. Operates all your barrels through all cycles - cleaning, pickling, plating, rinsing, bright dipping, etc. - any combination, all at the same time, automatically. Has all the flexibility of your present tank and hoist lines, but is completely automatic - no hoists, no manual operations.

#### ACCURATE

One control center - set it and forget it. Perfect timing and sequence in all processes to your exact requirements. Vary at will - any barrel — any cycle — by remote control.

#### ECONOMICAL

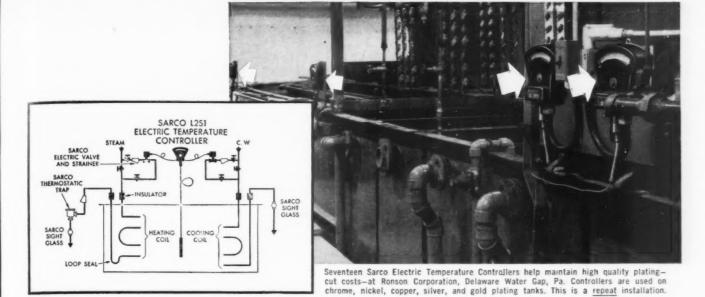
Greatest profit-earner of its kind. Add tanks and barrels to your lines as desired. Faster, better plating at a fraction of former costs. No more losses due to manpower shortages, confusion, carelessness, etc. Now you can "go automatic" for less — the G-S way.

### Another BIG Reason Why G-S means Greater Savings

Here's true automation! It adapts itself perfectly to your individual requirements. Another first offered by G-S - the first truly flexible tank line system. Perfected after years of development, it promises to revolutionize barrel plating. Entirely eliminates the "human element" between barrel loading and unloading. Speeds processing, ends inefficiency, ends time and error losses. Pays for itself in extra profits. Not complete new machinery. Not a radical plant re-design. Your present tanks and superstructures can stay on the job! Manual operations are out. More profits are in. G-S Tank Line Automation is here. See it next issue — this space.

### The G-S EQUIPMENT Co.

15585 Brookpark Rd. • Cleveland 11, Ohio • Clearwater 2-4774



# Improve plating quality—cut your costs with low-cost temperature control

Unstable bath temperatures . . . the result of erratic manual temperature control . . . are sure to lead to costly rejects, wasted man-hours and breakdown of plating solutions.

You can solve these problems at low cost... by installing always-reliable Sarco Automatic Temperature Control. Just think... a complete Sarco System is yours for as little as \$130 a tank!

- 1. You improve plating quality because creeping temperatures are a thing of the past.
- 2. You lower rejects because solutions are held automatically to

pre-set temperatures. No chance for human error to mess up a tankload...and cut into profits.

- 3. You get better utilization of time —platers are able to concentrate on their plating work. No worrying about bath temperatures. No turning on and off of valves.
- 4. You save plating solutions because automatic control prevents boil-off caused by overshooting temperature.

Write for Bulletin 1025-B or consult your plating supplies jobber. Sarco Company, Inc., Empire State Bldg., New York 1, N.Y.



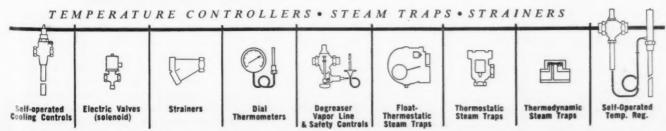
FOR AS LITTLE
AS \$130 A TANK!

Think of it . . . automatic temperature control that often pays for itself in weeks!

Easy-to-read controller dial clearly indicates temperature being maintained. Temperature setting quickly changed by turning one knob.

SARCO improves product quality and output

2224-B





## News about COATINGS for METALS

Metallic......Protective......Protective

## Chrome-like finishes produced at new low cost

## Time saved both in and out of chromium tank

Self-regulation is a must for the ultimate in fast chromium plating. Without it, there's still need for lengthy chemical analyses on solutions, and there's no assurance that baths are *always* in optimum plating balance.

Unichrome SRHS® Chromium is unique in that a reserve of chemicals is in the tank dissolving in just the amount to replenish losses. It thereby keeps the bath ingredients in optimum plating balance for best results. This not only saves time outside the tank on control tests, but also maintains high cathode efficiency and bright plate range. These in turn maintain high plating speed, enable a larger load to be covered per cycle, and minimize rejects and the waste of time and money they represent.

#### NEW CYLINDRICAL ANODE EXPOSES Larger effective surface

A new style of Unichrome round anode for chromium plating features a ribbed perimeter. The ribs give 75 current throwing edges or "points" in the 2" diameter anode, and 55 edges in the  $1\frac{1}{2}$ " anode.

This multipoint ribbed anode prevents trivalent chromium build-up in solutions where cathode area is large. It also offers the advantages of the original smooth round Unichrome Anode. These include longer life, better current distribution, high conductivity, resistance to warping. Send for data sheet RRA-1.

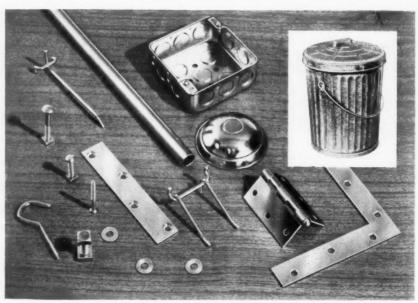
Unichrome is a trademark of Metal & Thermit Corp.



METAL & THERMIT

General Offices: Rahway, New Jersey
Pittsburgh • Atlanta • Detroit
East Chicago • Los Angeles
In Canada: Metal & Thermit—United Chromium
of Canada, Limited, Rexdale, Ont.

## New economical Unichrome Dip Compounds add sales appeal to zinc products



Typical products for which new economical Unichrome Dips are especially suited. Costs for dip compound are between 30¢ and 60¢ per 1000 sq. ft. of surface treated.

For the first time bright chromelike finishes become economically practical for electrical conduit, junction boxes, toy wheel goods, and other low cost zinc plated products including rough hardware. Economical chromate treating with newly developed Unichrome Dips is now being used to increase shelf life and sales appeal of even the most competitively priced products.

The new Unichrome Clear Dips operate at extreme dilutions. Make-up costs are low. So are operating costs, even where dragout is a factor. A unique feature of these Dips is their stability, which saves through long "mileage" and consistent results.

Use of these Unichrome Dips also cuts need for brighteners in the zinc bath, since products emerge from the chromating solution with chrome-like brilliance. In fact, one

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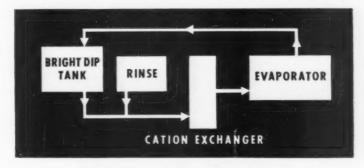
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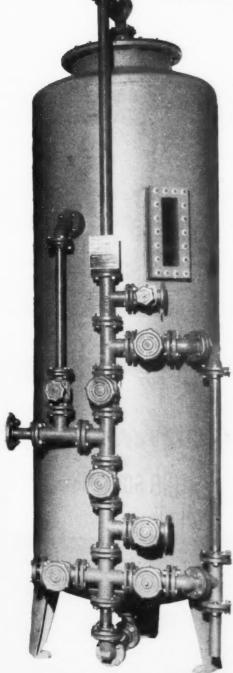
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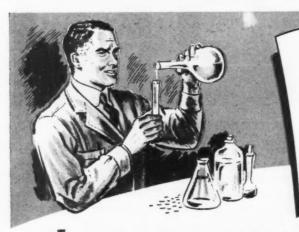


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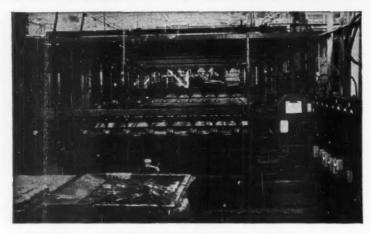
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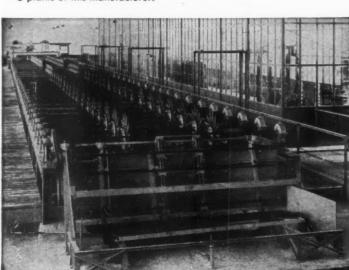
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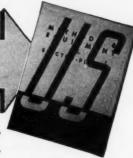
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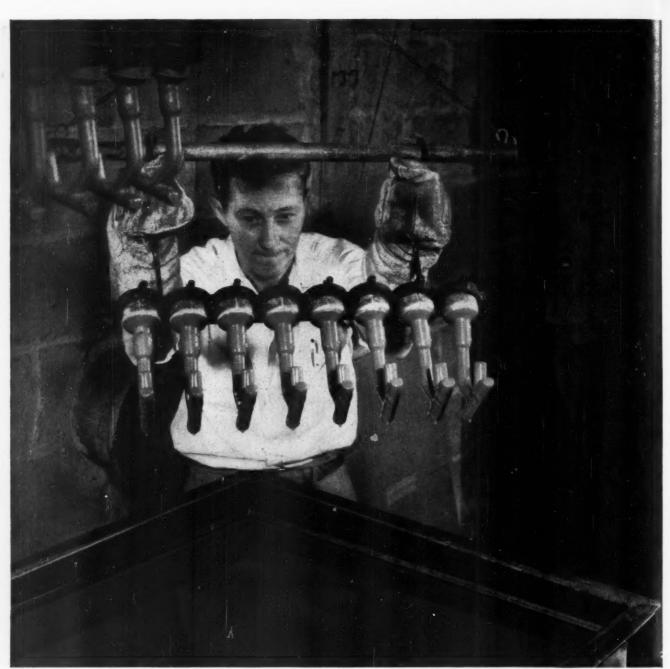


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NUMBER 9

SEPTEMBER, 1957

### The Newcomers — Germanium and Silicon

Germanium rectifiers are not new, having been introduced by the Germans almost twenty years ago. However, as recently as 1953, germanium power rectifiers were virtually unknown. There were the usual teething troubles in the beginning but, these having been overcome, American industry appears to be taking very kindly to germanium, if we may judge from the reports of its increasing popularity. It offers very high efficiency and evidences no aging effect. Germanium rectifiers have not been in use long enough to indicate their ultimate life, of course, but the period has been sufficient to indicate a reasonably long one. What has made germanium economically feasible, despite the high cost of the metal, is the enormous current capacity, ranging from 150 amperes per cell for fan-cooled to as high as 670 amperes per cell for liquid-cooled units. A small amount of germanium obviously goes a long way in such case, so that the price is competitive with selenium rectifiers. The small size, however, has presented the problem of thermal capacity, and fast-acting current limiting devices are required to take care of overloads caused by internal faults and external short circuits. Furthermore, they cannot be subjected to sudden high voltage surges. These are probably the only two disadvantages compared to selenium and have been compensated for in the proper design of the machines.

Silicon rectifiers, which are attracting growing interest, also have advantages. They not only can withstand higher voltages than germanium but can safely be operated at much higher temperatures than any other type of unit, up to 150° or even 200°C. Leakage currents are about one-fourth those of germanium and silicon does not appear to suffer from the same susceptibility to damage from momentary short circuits. However, it is more difficult and costly to manufacture. Development of silicon is somewhat behind that of germanium but, particularly in the higher voltage ranges, it seems to have better characteristics and this, together with its ability to operate under adverse temperature conditions, may enable it to establish a position of importance. The future will decide.

Selenium power rectifiers were a great improvement over the earlier magnesium-copper sulfide and the copper oxide types, offering greater efficiency, longer life and less sensitivity to high voltage puncture. They have been developed to a high degree of perfection and have occupied a strong position in our industry for years. Science does not stand still, however, and rectifier engineers are losing no time in seeking out materials, such as silicon carbide and other semi-conductors, for low voltage-high amperage requirements. In sight are operating temperatures up to  $1200^{\circ}\mathrm{F}!$ 

For those who already have made an investment in selenium rectifiers and might be experiencing some regrets as a result of the foregoing comments or advertising claims, we might point out that selenium is quite efficient also, and has the valuable characteristic of sealing itself after an overload under many conditions, so that it doesn't lose its rectifying property. Users can be sure that, maintained properly, the life of their selenium unit will give them no cause for complaint. Its many years of successful industrial application and its continuing popularity in the face of the more recent developments are the best proof.

Nathaniel Hall

## **ELECTROPLATING ON TITANIUM ALLOYS**

By L. Missel, Lockheed Missile Systems Division, Van Nuys, Calif.



Leo Missel received his B.S. degree from the College of the City of New York in 1936. He has been associated with Edgewood Arsenal, Alcoa, Bendix and Menasco Mfg. Company. In 1955 he joined the Missile Systems Division of Lockheed as a Manufacturing Research Engineer. He is a member of the Electrochemical Society and the American Electroplaters Society.

#### Introduction

THE use of titanium and titanium alloys has been limited by more serious surface limitations than those of any common metal. Not the least of its surface deficiencies are a tendency toward galling and seizing in loaded contact with itself and other metals, and poor resistance to oxidation at elevated temperatures. Chromium plating is an excellent solution to the galling and seizing problem for normal bearing applications. However, even high quality chromium plate will fail under moderately high bearing loads when used against bare titanium or titanium alloys. In such a combination both components should be electroplated. Chromium plating is also applicable to salvage work

For oxidation resistance, recent work by Harwood <sup>1</sup> suggests that the original chromium deposit may be of use as a base for a protective system such as the chromium-nickel layer plating procedure of Brenner.<sup>2</sup>

Electroplated copper is of value by itself and as a base for further plating to combat such difficulties as poor electrical and heat conductivity and poor solderability.

#### Discussion

Chromium of an order of adhesion comparable to that of chromium on steel has been successfully electrodeposited on the 5% chromium - 3% aluminum, 4% manganese - 4% aluminum and the 6% aluminum - 4% vanadium alloys\* of titanium. Exhaustive checking has shown adhesion and quality to be consistent and reliable. Some work has been done on the electrodeposition of copper on these alloys using the same pre-treatment procedures. The results indicate that copper with an order of adhesion greater than that of 60-40 solder to copper, and capable of

withstanding the heat of a soldering iron can be successfully plated.

A simple, reliable, semi-quantitative method for evaluating the adhesion of chromium to titanium and many other metals has been developed.

#### Plating Cycle

The plating cycle consists of the following operations:

- 1. Pre Activation Preparation (Removal of all surface contamination except the normal oxide film)
- 2. Activation
- 3. Undercoat Plating (if required)
- 4. Plating

#### PRE-ACTIVATION TREATMENT

The pre-activation treatment consists of the following operations:

- Remove all scale, heavy oxide, etc., by mechanical means. Grinding is particularly recommended for this operation. Sulfated oils are satisfactory as coolants.
- 2. Remove coolant by rinsing.
- 3. Dry parts.
- 4. Solvent degrease if necessary.
- Activate as described under individual alloy.

#### ACTIVATION

The activation treatment for the different alloys

#### TABLE I.

## Activation Treatment for 4% Mn - 4% Al and 6% Al - 4% V Alloys

- Immerse in the following solution at room temperature to evolution of red fumes:
  - 60% Hydrofluoric acid 1 volume 69% Nitric acid 3 volumes
- 2. Rinse thoroughly with distilled or deionized water (spray preferably)
- 3. Immerse in the following solution:
  Sodium dichromate 33 oz./gal.
  60% Hydrofluoric acid 6.2 fl. "
  Distilled or deionized water Balance
  Time: 20 minutes
  Temp: 180°F to boiling
- Rinse thoroughly in cold running tap water.

<sup>\*</sup>See Appendix for equivalent alloy designations

varies. The treatment for the 4% Mn - 4% Al and the 6% Al - 4% V alloys is given in Table I. The three alternative, applicable activation treatments for the 5% Cr - 3% Al alloy are given in Tables II, III and IV.

The  $HNO_3$  - HF treatment is the first step of a two step activation process. Other solutions, such as HF -  $H_2SO_4$ , HF - HC1, HF -  $CrO_3$  and HF -  $H_2O_2$ , when used prior to the final step of the activation treatment, result in inferior plate adhesion.

#### PLATING OR UNDERCOAT PLATING

After activation and rinsing, the work is transferred to a standard chromium bath ( $CrO_3$ —33 oz./gal.,  $SO_4$ —0.33 oz./gal.) or to a standard acid copper sulfate bath and plated. No entry with current on or other special precaution is required.

Masking: Chlorinated paraffin, applied by dipping the parts in the molten wax, has been very satisfactory for partial stopoff during chromium plating. However, the problem of chromic acid contamination due to bleeding makes its use during copper plating extremely risky.

Pressure sensitive vinyl tape is very adequate for the procedures of Tables III and IV. Pressure sensitive Teflon tape provided good protection in all cases when used during the investigation; however, difficulties were encountered with the adhesive. With the improved adhesives now available, this problem should be eliminated.

For use as robbers or shielding to prevent edge build-up or as a conductive mask, titanium appears to be the most practical material.

Fixtures: Any bare metal surface of the fixture or contacts must be made of titanium or covered with a metal such as gold or platinum which resists the action of the activation solutions.

Chlorinated paraffin applied by dipping in the molten wax, and presumably fluorcarbon products are suitable rack coating materials.

Water: Experimental evidence indicates that the use of distilled or deionized water for rinsing the 4% Mn-4% A1 and the 6% A1 · 4% V alloys after the HNO<sub>3</sub>-HF dip and in the formulation and make-up of the Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> · HF solution is required. A tap water rinse can be used after activation. This is not essential for limited use with the 5% Cr · 3% A1 alloy; however, because of the rapid rate of evaporation in the high temperature activation baths, and because of rapid accumulation of hard water salts whose cumulative effect is not known, prudence dictates the use of distilled or deionized water with this alloy.

Post Bake: Post bake is unnecessary for good adhesion, as with some other methods.

Plate Thickness: Chromium of 0.020" thickness and copper of 0.001" thickness have been plated with good adhesion. This does not appear to be the maximum attainable.

Tank linings: Carbon brick is probably the most prac-

#### TABLE II.

## Activation Treatment for 5 % Cr - 3 % Al Alloy (Alternate)

 Immerse in the following solution at room temperature to evolution of red fumes:

> 48% - 60% Hydrofluoric acid \_\_\_1 volume 69% Nitric acid \_\_\_\_\_ 3 volumes

- 2. Rinse thoroughly with water.
- Rinse thoroughly in cold running tap water

#### TABLE III.

## Activation Treatment for 5 % Cr - 3 % Al Alloy (Alternate)

 Immerse in the following solution at room temperature to evolution of red fumes:

> 48% - 60% Hydrofluoric acid 1 volume 69% Nitric acid 3 volumes

- 2. Rinse thoroughly with water.
- 3. Immerse in the following solution:

4. Rinse thoroughly with cold, running tap water.

#### TABLE IV.

## Activation Treatment for 5 % Cr - 3 % Al Alloy (Alternate)

 Immerse in the following solution at room temperature to evolution of red fumes:

48% - 60% Hydrofluoric acid \_\_\_ 1 volume 69% Nitric acid \_\_\_\_ 3 volumes

- 2. Rinse thoroughly with water.
- 3. Immerse in the following solution:

  Copper sulfate 30 oz./gal.

  52% Hydrofluoric acid 1.3 fl. oz./gal.

  Distilled or deionized water Balance
  Time: 30 seconds
  Temp: 200°F to boiling
- 4. Rinse thoroughly with cold, running tap water.

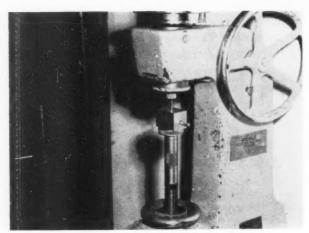


Figure 1. Test Fixture for Applying Load.

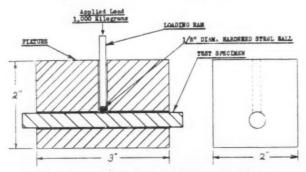


Figure 2. Fixture For Steel Ball Indentation Test.

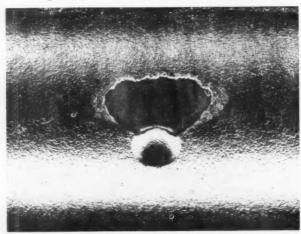


Figure 3. Steel Ball Indentation Test. Fair Rating (10X magnification).

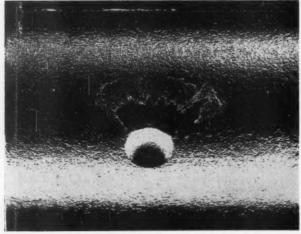


Figure 4. Steel Ball Indentation Test. Good Rating (10X magnification).

tical material for the HNO<sub>3</sub>-HF solution. The resistance of chlorosulfonated polyethylene to the other solutions is being investigated. Vinyl lining are satisfactory for rinse tanks.

Heaters: Impervious graphite heaters appear to be necessary.

Stripping: Nitric acid performs well in stripping copper. A mixture of nitric and hydrochloric acids is not as effective as hydrochloric acid alone for stripping chromium, but involves less risk of hydrogen embrittlement. The dimensional loss of the titanium occuring during an activation, plate, strip cycle is insignificant.

Analytical Control: No attempt has been made to work out analytical control methods. The steel ball indentation test can be used for following changes in the bath.

#### Deposit Evaluation

Since appearance is no indication of deposit quality, the following methods were used:

#### CHROMIUM

Bearing and steel ball indentation tests have been described by Missel.<sup>3</sup> In the steel ball indentations test fracture is forced by applying a 2000 kg load to the plate with an ½" hardened steel ball (Rockwell H and K scales). A Brinell tester or a tensile tester is suitable for applying the load. (See Fig. 1, 2). The appearance of the fracture at 10X magnification is an excellent indication of the magnitude of adhesion. Test ratings are described in Table V.

TABLE V
Steel Ball Indentation Test Ratings

Rating	Appearance of Fracture						
Poor	Clean break at interface with no plate shear						
Fair	Some plate shear; little or no residual chromium in "bare" area. (Fig. 3)						
Good	Better plate shear, more residual chromi- um in "bare" area. (Fig. 4)						
Excellent	<ul> <li>(a) No fracture under 2000 kg load or</li> <li>(b) Extensive tapered plate shear with many chromium spots in "bare area (Fig. 5)</li> </ul>						

It must be emphasized that this is an exceedingly

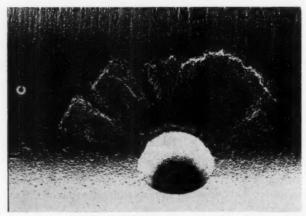


Figure 5. Steel Ball Indentation Test. Excellent Rating (10X magnification).

### 0.005" - 0.007" Chromium Deposited on 5 % Cr - 3 % Al Alloy Using CuSO<sub>4</sub> - HF Pretreatment

Sample #	CuSO 5.5H 2O oz. /gal.	HF (52%) fl. oz./gal.	Time in Immersion Bath (Sec.)	Temp. of Immersion Bath (°F)	Visual Appearance of Chromium	Steel Ball Indentation Test
1	30	1.3	30	75	Poor	-
2	30	1.3	60	75	Excellent	Very poor, large flakes
3	30	1.3	120	75	Poor	_
4	30	1.3	5	160	Excellent	Very poor, large flakes
5	30	1.3	15	160	Bad Spot	-
6	30	1.3	30	160	Excelient	Very poor, large flakes
7	30	1.3	5	200	Excellent	Poor - Failed at interface
8	30	1.3	15	200	Excellent	Poor - Failed at interface
9	30	1.3	30	200	Excellent	Poor - Failed at interface
10	30	3.9	15	200	Fair	_
11	30	3.9	30	200	Fair	-
12	30	7.8	15	200	Poor	-
13	30	7.8	5	75	Poor	-
14	30	7.8	15	75	Poor	-
15	30	7.8	30	75	Poor	_
16	6	3.9	5	200	Excellent	Very poor, large flakes
17	6	3.9	15	200	Excellent	Very poor. large flakes
18	- 6	3.9	30	200	Excellent	Very poor, large flakes
19	6	3.9	60	200	Poor	_
20	1.3	3.9	30	200	Non-adherent copper film on immersion	

severe test since test pieces of "poor" rating, which merely fail at the interface without producing large flakes, consistently stand up under centerless grinding. This operation in itself requires considerable plate adhesion to avoid failure.

This test is also applicable to chromium plate on steel and many other metals. Standards of the actual chromium plated metal are necessary for proper evaluation.

#### COPPER

The adhesion of copper deposits, during the in-

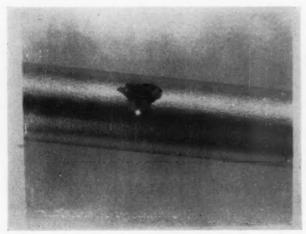


Figure 6. Typical Fracture. 4% Mn-4% A1 Alloy (8X).

vestigation, was checked by soldering copper wire to the plate using an active flux and 60 Sn - 40 Pb solder. The wire was pulled off the test piece and the fracture examined for evidence of bare titanium.

#### APPEARANCE

Good appearance of the plate is no indication of good adhesion. Apparently even a slight degree of adhesion will produce a uniform deposit, free from nodules, pitting, cracks, or other undesirable phenomena.

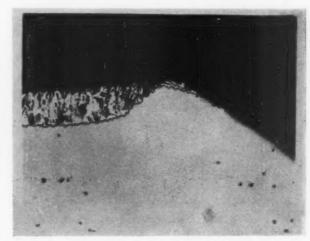


Figure 7. Metallographic Section at Fracture of Cr Plated 4 at Mn-4% A1 Titanium Alloy (500X magnification).

#### Solution Maintenance

No attempt has been made to work out solution maintenance or impurity removal procedures. These will present a serious problem with extended bath operation, due to loss of hydrofluoric acid by complexing, hydrogen ion depletion reduction of dichromate, and accumulation of titanium and alloying elements in the bath. In the development of these methods a surface area corresponding to approximately 500 sq. in. per gallon of dichromate or copper sulfate activating solution was treated and the solution discarded. However, the active life of the non-maintained solution is above this figure which was chosen because of convenience rather than loss of activating ef-

fectiveness. The working out of effective solution maintenance and analytical control methods should present no serious difficulty.

It would not be practical to purify the  $HNO_3$ - HF solutions, but experience has shown that they are suitable for use on an extremely large surface area before they lose their effectiveness. A chlorinated paraffin lined container of this material was used daily for several months before replacement was required.

Both chemically pure and technical grade chemicals were evaluated. Unlike water, whose purity was critical, the technical grade chemicals gave results as good as the chemically pure grade.

TABLE VII.

0.005" - 0.007" Chromium Deposited on 5 % Cr - 3 %
Al Alloy Using Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> - HF - Heavy Metal Salt Pretreatment

Sample	NasCr207.2H3O	HF (52%) fl. oz./gal.	CuSO;,5HzO	Other ox./gal.	Time in Immersion Bath (Sec.)	Temp. of Immersion Bath (°F)	Appearance	Steel Ball Indontation Test
1	13.5	1.3	0.7	distribution.	60	75	Excellent	Poor
2	13.5	6.5	0.7	-	60	75	Excellent	Poor
3	0	6.5	0.7	$10 \cdot CrO_3$	60	189	Excellent	Fair
4	13.5	6.5	0.7		20	186	Excellent	Good
5	13.5	6.5	0.7	departments.	60	185	Excellent	Excellent
6	13.5	6.5	0.7	ALIEN CAREER	180	185	Excellent	Good
7	13.5	1.3	3.3	_	60	185	Excellent	Good
8	40	6.5	2		60	189	Excellent	Good
9	40	6.5	2		60	186	Excellent	Good
10	13.5	6.5	0.7		60	186	Excellent	Good
11	13.5	6.5	0	-	60	184	Excellent	Poor
12	13.5	6.5	0		20	188	Excellent	Poor
13	13.5	1.3	0.7	and the same of th	60	188	Excellent	Good
14	13.5	3.9	0.7		60	185	Excellent	Good
15	13.5	22	0.7		5	187	Violent reac copper de	tion with spongy eposit
16	13.5	6.5	0	$\begin{array}{c} 0.3 \\ \mathrm{Ag_2SO_4} \end{array}$	60	187	Excellent	Very good
17	13.5	6.5	0	0.7 ZnSO <sub>4</sub> ·7H <sub>2</sub> O	60	185	Excellent	Excellent - slightly superior to #5
18	13.5	6.5	0	1 Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> ·9H <sub>2</sub> O	60	186	Excellent	Poor
19	13.5	6.5	0	0.4 CdC1 <sub>2</sub> ·2½H <sub>2</sub> 0	60	186	Excellent	Very good
20	13.5	6.5	0	0.7 CoCl <sub>2</sub> ·6H <sub>2</sub> O	60	186	Excellent	Poor
21	13.5	6.5	0	0.7 NiCl <sub>2</sub> ·6H <sub>2</sub> O	60	185	Excellent	Very good
22	13.5	6.5	0	0.3 SnCl <sub>2</sub> ·2H <sub>2</sub> O	60	185	Excellent	Poor
23	13.5	6.5	0	0.25 ZnSO <sub>4</sub> ·7H <sub>2</sub> O	60	185	Excellent	Excellent
24	13.5	6.5	0	2 ZnSO <sub>4</sub> ·7H <sub>2</sub> O	60	188	Excellent	Excellent
25	13.5	6.5	0.7	0.7 ZnSO <sub>4</sub> ·7H <sub>2</sub> O	60	188	Excellent	Good - inferior to
26	13.5	6.5	0	0.7		188	Excellent	Cu or Zn alone Excellent
				ZnSO <sub>4</sub> ·7H <sub>2</sub> O	60			

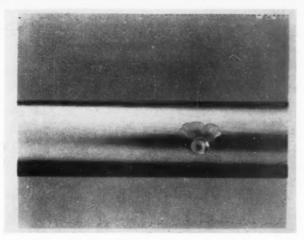


Figure 8. Typical Fracture. 6% A1-4% V Alloy (8X).

#### 5 % Cr - 3 % Al Alloy

Experimental data on the three alternate activation methods developed for the 5% Cr - 3% Al alloy are presented in Tables VI, VII and VIII. The CuSO<sub>4</sub> - HF method of Table VI gives only a "poor" rating with the very stringent steel ball indentation test, and is of dubious value as a pretreatment for chromium plate used under the extreme loads toward which this work was directed. However, it results in sufficient adhesion when used as a base for chromium to consistently stand up under centerless grinding, and to easily pass the solder test when used as a base for copper.

The  $Na_2Cr_2O_7$  - HF method of Table VIII gives the most adherent plate; however, the advantage obtained is not of sufficient magnitude to warrant overlooking the highly adherent plate resulting from use of the  $Na_2Cr_2O_7$  - HF - heavy metal salt method of Table VII. Operating conditions are less critical, immersion time is materially less, and any tendency for moderate granularity of the plate at the upper limits of HF concentration is eliminated.

Of the three alloys studied, the 5% Cr - 3% A1 alloy exhibits the greatest activity toward treatment reagents. It requires the lowest HF concentration in the  $HNO_3$ - HF mixture and the highest  $Na_2Cr_2O_7/HF$  ratio for controlling the activation, as well as requiring

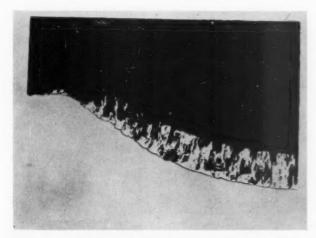


Figure 9. Metallographic Section at Fracture of Cr Plated 6% A1-4% V Titanium Alloy (500X magnification).

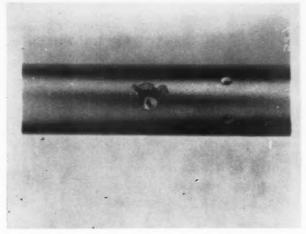


Figure 10. Typical Fracture, 5% Cr-3% A1 Alloy (8X).

closer and more meticulous bath control than for the 4% Mn - 4% Al and the 6% Al - 4% V alloys,

In all these baths the HF is the most critical component with regard to concentration. Its optimum range is highly dependent on the actual Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> or CuSO<sub>4</sub> concentrations. Therefore, close control of the more easily controlled Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> or CuSO<sub>4</sub> is of advantage in allowing a wider permissible range for the more easily depleted and more difficult to control HF. This results in easier control and more foolproof operation of the bath.

The CuSO<sub>4</sub>-HF bath must be operated at a higher temperature than any of the other baths. Temperatures above 200°F should be used. Best results are obtained with a 30 second immersion time and a high copper concentration. HF is critical, and must be of low concentration (see Table VI). Experimental evidence, untabulated here, shows high tolerance to high concentrations of many acids. Trivalent titanium buildup in continued operation must be prevented or finely divided copper will appear in the solution.

The work with the  ${\rm Na_2Cr_2O_7}$  - HF - heavy metal salt method was done with both distilled and tap water with equally good results for the limited surface area treated in the bath. However, as noted in the section

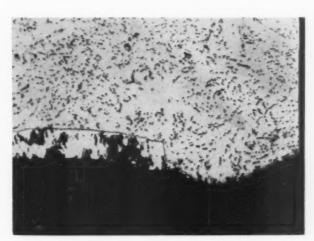


Figure 11. Metallographic Section at Fracture of Cr Plated 5% Cr-3% A1 Alloy (500X magnification).

TABLE VIII.  $0.005'' \cdot 0.007'' \ \textit{Chromium Deposited on 5 \% Cr - 3 \%}$ 

Al Alloy Using Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> - HF Pretreatment

Sample #	NasCr207.2HsO	HF (60%) fl. oz./gal.	Time in Immersion Bath (Min.)	Temp. of Immersion Bath (°F)	Appearance	Steel Ball Indentation Test
1	39	6.2	10	200	Excellent — slightly granular	Excellent
2	39	6.2	20	200	Excellent —	Excellent
					slightly granular	
3	39	3.2	5	184	Excellent	Good
4	39	3.2	10	188	Excellent	Excellent
5	39	3.2	10	184	Excellent	Good
6	39	3.2	20	188	Excellent	Good
7	52	3.2	10	188	Excellent	Excellent
8	52	3.2	20	188	Excellent	Excellent
9	52	3.2	10	185	Excellent	Excellent
10	52	3.2	20	185	Excellent	(tap water substituted Excellent
		7,7				(tap water
13	50	0	3.0	100	Б н	substituted
11	52	2 2	10	183	Excellent	Excellent
12	52		20	183	Excellent	Excellent
13	52	4.6	10	184	Excellent —	Excellent
14	52	4.6	20	184	slightly granular Excellent — slightly granular	Excellent

TABLE IX

0.005" - 0.007" Chromium Deposited on 6 % A1 - 4 % V Alloy
After Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> - HF Pretreatment

Sample #	NazCrz07,2HzO	HF (60%) H. oz./gal.	Time in Immersion Bath (Min.)	Temp. of Immersion Bath (°F)	Appearance	Steel Ball Indentation Test
1	52	6.2	20	188	Excellent	Fair
2	52	6.2	20	188	Excellent	Poor
3	39	6.2	10	188	Excellent	Excellent
4	39	6.2	20	187	Excellent	Excellent
5	25	6.2	10	188	Excellent	Excellent
6	25	6.2	20	188	Excellent	Excellent
7	13	6.2	10	191	Excellent	Fair
8	13	6.2	20	191	Excellent	Fair
9	25	3.2	10	186	Excellent	Excellent
10	25	3.2	20	186	Excellent	Good
11	25	4.4	10	186	Excellent	Excellent
12	25	4.4	20	186	Excellent	Excellent
13	25	7.4	10	186	Excellent	Excellent.
14	25	7.4	20	186	Excellent	Excellent
15	25	9.1	10	187	Excellent	Fair
16	25	9.1	20	187	Excellent	Fair
17	39	6.2	10	191	Excellent	Poor
						(Tap water substituted)
18	39	6.2	20	191	Excellent	Poor
						(Tap water substituted)

TABLE X
0.005" - 0.007" Chromium Deposited on 4 % Mn - 4 % Al Alloy
After Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> - HF Pretreatment

Sample ##		ИГ (60%) Я. ох./gal.	Time in Immersion Bath (Min.)	Temp. of Immersion Bath (°F)	Appearance	Steel Ball Indentation Test
1	13	6.2	20	189	Excellent	Fair
2	25	6.2	20	188	Excellent	Excellent
3	25	6.2	20	188	Excellent	Excellent
4	39	6.2	20	190	Excellent	Excellent
5	39	6.2	20	190	Excellent	Excellent
6	52	6.2	20	190	Excellent	Excellent
7	52	6.2	20	190	Excellent	Excellent
8	64	6.2	20	191	Poor	_
9	64	6.2	20	191	Poor	-
10	33	3.2	10	186	Excellent	Good
11	33	3.2	20	186	Excellent	Excellent
12	33	4.9	10	187	Excellent	Excellent
13	33	4.9	20	187	Excellent	Excellent
14	33	8.1	10	188	Excellent	Excellent
15	33	8.1	20	188	Excellent	Excellent
16	33	9.8	10	189	Excellent	Good
17	33	9.8	20	189	Excellent	Excellent
18	33	6.5	10	188	Poor	-
19	33	6.5	20	188	(Tap water substituted) Poor	
					(Tap water substituted)	

TABLE XI
0.005" - 0.007" Chromium Deposited on 4 % Mn - 4 % Al Alloy
After Pretreatment in Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> - HF Containing Heavy Metal Salt

Sample #	NasCr207.2H2O	HF (60%)	NICIs.6HgO	Other es./gal.	Time in Immersion Bath (Min.)	Temp. of Immersion Bath (°F)	Appearance	Steel Ball Indentation Test
1	13	3.2	0	0.7	20	187	Excellent	Good
				$CdC1_2$ · $2\frac{1}{2}H_2O$	20			
2	13	3.2	0	0.7	20	190	Excellent	Good
3	19		0	CoCl <sub>2</sub> ·6H <sub>2</sub> O	00	100	E 11	C1
3	13	3.2	0	0.7 CuSO <sub>4</sub> ·5H <sub>2</sub> O	20	189	Excellent	Good
4	13	3.2	0	0.7	20	189	Excellent	Fair
4	10	0.2	U	ZnSO <sub>4</sub> ·7H <sub>2</sub> O	20	109	Lacenent	1 411
5	13	1.9	0.7	211304 11120	20	189	Excellent	Fair
6	13	3.2	0.7	_	20	190	Excellent	Good
7	13	3.2	2	-	20	189	Excellent	Good
8 .	13	4.3	0.7		20	186	Excellent	Good
9	13	4.3	0.7	_	20	185	Excellent	Poor
*								(Tap water substituted
10	13	6	0.7	-	10	192	Tendency	Good
16-							to pit	
11	13	6	0.7	_	20	192	Tendency	Good
	, .						to pit	_
12	6.5	3.2	0.7		20	184	Excellent	Poor
13	52	3.2	0.7	_	20	184	Excellent	Good
14	52	6.2	0.7	_	20	192	Excellent	Good
15	52	6.2	0	_	20	190	Excellent	Excellent
16	. 52	6.2	2	-	20	192	Excellent	Good

on water, it would be prudent to use distilled or deionized water for extended operation. This is a very smoothly operating bath. There are indications of high tolerance to cation impurities and since even changing the entire Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> content to CrO<sub>3</sub> produced a fair rating with the steel ball indentation test, substantial tolerance to acid is indicated. Experimental work with 13.5 - 40 oz./gal. Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> produced no worse than "good" ratings. There appears to be no advantage in going to high Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> concentrations since there is no pitting or granularity problem. At 13.5 oz./gal. Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>·2H<sub>2</sub>O no worse than "good ratings were obtained with 1.3 - 6.5 fl. oz./gal. HF (52%) and 0.7 -3.3 oz./gal. CuSO<sub>4</sub> . 5H<sub>2</sub>O. Temperature is critical and should be maintained above 180°F. Best results were obtained with 60 seconds immersion time; however, a reasonable deviation can be tolerated (see Table VII).

The work with the  $\rm Na_2Cr_2O_7$ - HF bath was likewise done with distilled and tap water with the same results. Of the baths studied for the 5% Cr - 3% A1 alloy, this bath results in the best plate adhesion, but requires the most careful control because of a tendency to produce slightly granular plate at higher HF concentrations. At 39-52 oz./gal.  $\rm Na_2Cr_2O_7.2H_2O$  no worse than "good" adhesion test ratings without granularity were obtained with 2 - 3.2 fl. oz./gal. 60% HF. Temperatures above  $\rm 180^{\circ}F$  and immersion times of  $\rm 10\text{-}20$  min. are satisfactory (see Table VIII). Better results are obtained as the temperature is increased and with 20 min. immersion.

#### 4 % Mn - 4 % Al and 6 % Al - 4 % V Alloys

Activating bath composition overlap makes it possible to prepare a formulation applicable to both of these alloys. Tables IX and X indicate that a considerable area of overlap in the HF concentration can be found at approximately the 30 oz./gal. Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>.2H<sub>2</sub>O level. This is a very smoothly operating bath, particularly for the 6% A1 - 4% V alloy.

The 4% Mn - 4% Al alloy exhibits a tendency for pits to form in the basis metal after a number of plate and strip cycles at the top HF range. The tendency is considerably minimized at high Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> concentrations. It is entirely absent at slightly lower HF concentrations, such as would be used with a bath also applicable to the 6% Al - 4% V alloy. This tendency to pit has not been observed with the 6% Al - 4% V alloy.

Distilled or deionized water was used in the experimental work. It was found to be necessary for the activating solution and after the HNO<sub>3</sub> - HF treatment for good adhesion. It is not necessary for the post-activation rinse.

As with the 5% Cr - 3% A1 alloy baths, it is wise to control Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> concentration closely to permit more latitude with the HF concentration.

All baths should be operated at a temperature in excess of 180°F. Better results are obtained as the temperature is increased. Immersion time is 10-20 with 20 min. generally most favorable.

At 25 oz./gal.  $Na_2Cr_2O_7.2H_2O$ , concentrations of  $3.2 \cdot 7.4$  fl. oz./gal. 60% HF resulted in good adhesion on the 6% A1 - 4% V alloy, with indications that a

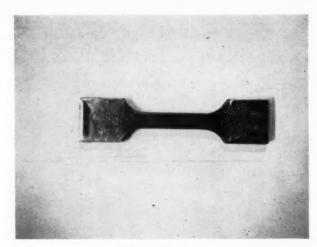


Figure 12. Test Bar of 5% Cr-3% A1 Titanium Alloy With Grip Ends Copper Plated and Dip-Soldered.

slightly higher  $Na_2Cr_2O_7$ :2 $H_2O$  concentration will give a reasonable HF (60%) range (see Table IX).

At 33 oz./gal. Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>·2H<sub>2</sub>O, concentrations of 3.2 · 9.8 fl. oz./gal. of 60% HF resulted in good adhesion on the 4% Mn · 4% Al alloy with indications that a higher Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>·2H<sub>2</sub>O concentration is acceptable. Such solutions contain sufficient Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> to permit control of pitting (See Table X). The results of Table XI, taken from the preliminary experiments, indicate that the solution is not seriously affected by some types of contamination when used for activation of the 4% Mn · 4% Al alloy.

#### Conclusions

It is plausible to assume that other titanium alloys can be plated using the same or substantially the same procedures. The solutions described give excellent results; however, it is obvious that they are of limited life. An attempt has been made to point-up their deficiencies for continuous use and to indicate what further work is needed to extend their life.

#### Acknowledgment

This work was done at and for the *Menasco Mfg. Co.* of Burbank, Calif. to whom patent applications covering the above have been assigned, and with whose permission this work is being published.

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#### Appendix

Equivalent Designations of Titanium Alloys

5% Cr - 3% A1 4% Mn-4% A1 6% A1 - 4% V

AMS 4927 AMS 4925 MIL-T-009046

MST 3A1 5 Cr C-130 AM Class 2

MIL-T-9047 MST 4Mn 4A1 C120AV

RC 130 B

Class 3 RS 130 Ti-6A1-4V

MIL-T-9047 MST 6A1 4V
Class 6 MIL-T-9047
Class 5

# The Effects of Ultrasonics on the Electrolytic Deposition of Metals\*

By A. Roll, Max-Plank-Institute for Metal Research, Stuttgart, Germany

#### Abstract

THE present paper gives a brief summary report on the effects of ultrasonics in electroplating as far as information is available in the literature. Few systematic papers have been published on this subject aside from some scattered references. This may well be understood when considering that a rather complex physical process, namely ultrasonics, is superimposed on cathodic deposition, a process not yet fully investigated in every detail. It is possible to give an exact formal definition of ultrasonics. It is difficult, though, and sometimes impossible under certain experimental conditions and in a defined experimental space, to determine necessary parameters with the precision required for scientific measurements. Still the results available so far from investigations<sup>1-10</sup> are sufficient to establish the effects of ultrasonics on the specific process of electroplating in a qualitative and, partially, even in a semi-quantative manner.

#### Results of Investigations

All systematic investigations published heretfore have shown that no effects are produced by ultrasonics treatment on such commercially important electrodeposits as copper, nickel, chromium, or silver which would justify the increased cost and complexity of operation. The same effects can generally be achieved with highly developed plating solutions under suitable conditions of deposition. This statement required some restrictive interpretation. Because of the nature of the known generating processes for intensive ultrasonic waves, experiments necessarily were limited to relatively small surfaces (a few square centimeters). Where such small areas are sufficient, such as in gold plating, ultrasonics are being used in several installations. It is unfortunate that the reasons for such use and the results achieved have not been published anywhere. If it should eventually become possible to treat larger bodies of solution suitable for larger work surfaces with ultrasonic oscillations of adequate strength and uniform density, electroplating with ultrasonics might possibly become of interest for other metals as well. Some attempts have been made in this direction, but only the future will tell of their success or failure.

When applying ultrasonics, several possible arrangements may be considered. The cathode may be made to oscillate (at right angles or parallel to its surface) or the cathode may be stationary, with the sound beam striking it at right angles to the surface or passing parallel to it. Where not specifically indicated otherwise, the following results were obtained by the latter method.<sup>5-9</sup> This experimental set-up is most readily effected and yields reproducible results. When ultrasonics are applied on a commercial scale, only this relative position of sound beam and work would be practical.

The effect of ultrasonics on cathode processes is defined primarily by the intensity of sound J and the corresponding sound wave pressure S = J/v (v = velocity of sound in the electrolyte). This sound wave pressure may be described rather loosely but plausibly

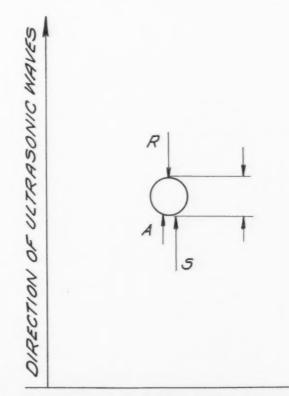


Fig. 1. Forces acting upon a small gas bubble in an ultrasonic field.

<sup>\*</sup>Translated from a paper presented at a symposium arranged at Geislingen-Steige by the Research Institute & Assaying Laboratory for Noble Metals, Schwäbisch-Gmünd, and the Research Association of the Sheet Metal Industry, Düsseldorf, South German Branch, and published in Metalloberfläche.

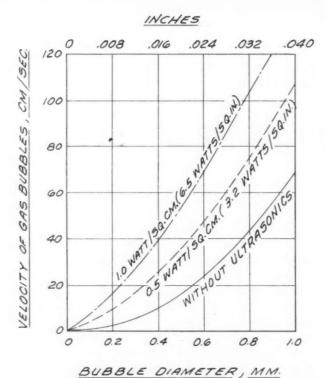


Fig. 2. Effect of ultrasonics on velocity of rise of gas bubbles.

as the force of rebound exerted by a sound wave on a reflecting obstacle.1 It is independent of frequency and its magnitude, for example in water at complete reflection with the formation of standing waves, is approximately 70 mg./cm.2 (1/1,000 psi). When a sound wave meets a small gas bubble in a liquid, the gas bubble is acted upon by its buoyancy A, the force of friction R working in the opposite direction, and also by a third force S which is caused by the pressure of the sound wave on the bubble. If the sound wave is directed vertically upward as indicated schematically in Fig. 1, the buoyancy is increased by the sound pressure and the bubble will move upward with increased velocity. Because of friction, the liquid in the vicinity of the bubble will also flow faster than without ultrasonics. If the velocity of liquid flow is assumed to be, for example, one fifth of the velocity of the bubble, the velocities at various intensities of

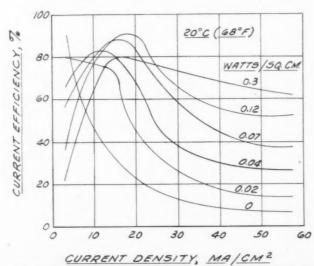


Fig. 3. Effect of intensity of ultrasonics on current efficiency of nickel plating.

sound for bubbles of various diameters will be as shown in Fig. 2 indicating a substantial increase with ultrasonics.<sup>10</sup>

In practical electroplating, a metal is never deposited at 100% current efficiency; some hydrogen always develops. After combining into molecules, this hydrogen accumulates at the cathode surface in small visible bubbles. These bubbles may adhere for a while to the surface or they may keep growing and finally detach themselves from the surface. For the reasons outlined above, such bubbles are immediately attacked in an ultrasonic field and are driven off by the pressure of the sound beam. When a cathode in an ultrasonic field of a few tenths of a watt intensity is visually inspected under conditions of moderate hydrogen development, it always appears bright, whereas, it immediately covers with an opaque film of hydrogen bubbles as soon as the ultrasonic oscillations are stopped.

Because of the increased speed of the bubbles as compared to a solution at rest, the flow of the electrolyte is accelerated, and this effect is most pronounced where the equalization of concentration associated with it is most beneficial, namely at the boundary

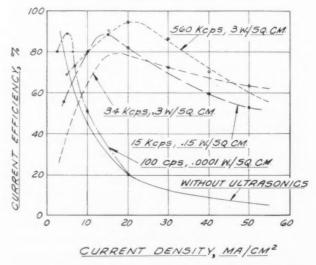


Fig. 4. Effect of frequency and intensity of ultrasonics on current efficiency of nickel plating at 20°C.

layer in which the ion-discharge takes place and where the hydrogen is generated.<sup>5</sup> Ultrasonic oscillations, therefore, result in agitation of an intensity which can hardly be equalled by mechanical means.

Fig. 3 shows the effect of this agitation on the current efficiency of a bright nickel bath of relatively low metal content. As the intensity of sound grows, the formation of hydrogen is suppressed more and more in favor of metal deposition.

Fig. 4 shows the effect of a few selected conditions of ultrasonics on the relationship between current efficiency and current density in the same solution. Fig. 5 shows the agitation effect of ultrasonics in an even clearer manner. Even where the current density in the stationary solution is raised beyond approximately 10mA/cm.<sup>2</sup> (9 amp./sq. ft.), the number of ions available for discharge does not increase. The supply of nickel ions in the boundary layer of the

electrolyte is exhausted. Agitation (with a small highspeed stirrer close to the cathode surface) as well as ultrasonics tend to alleviate this condition, ultrasonics being clearly superior to mechanical agitation.

The cathodic deposition potential of nickel which can be determined from the measured potential and the current efficiency for nickel is extremely sensitive to this equalization of concentration in the boundary layer. This is evident from the practically linear shape of the curves in Fig. 6 for higher intensities of sound.

Intensive ultrasonics can be seen to act electrochemically in the same direction as intensive agitation, but to be superior to it.

We shall now discuss the effect of ultrasonics on the surface of the deposited metal coating using a nickel plate as an example. Fig. 7 shows schematically the various types of surfaces produced at varying current densities and other experimental conditions. The bright plating range shifts to higher current density values with agitation, even more so under the influence of ultrasonics of increasing intensity. Whereas, in a stationary solution brightest deposits are obtained at approximately 2.7 mA/cm.<sup>2</sup> (2.5 amp./ sq.

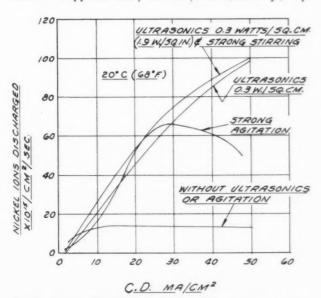
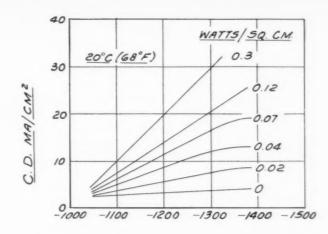


Fig. 5. Number of nickel atoms deposited per second on 1 cm<sup>2</sup> under various conditions.

ft.), the same degree of brightness at only slightly reduced current efficiency can be achieved at 40 mA/cm.<sup>2</sup> (38 amp./sq. ft.) with ultrasonics (34 kc., 0.3 watts/cm.2). The streaks appearing on the nickel plate at higher current densities in the stationary bath are eliminated by ultrasonics, as the gas bubbles can no longer rise along the vertical surface of the cathode. The same thickness of plate, therefore, can be produced from this bath in less than one tenth of the time required for a stationary solution. This effect does not have much practical importance because suitable nickel solutions of high metal content are capable of the same results by simpler means. The same observations were made in a copper solution of similar composition, whereas, conditions are less clear with chromium. No bright deposits could be obtained from a standard cyanide silver solution. Our experience to date does not indicate that ultrasonics alone create brightness.



#### DEPOSITION POTENTIAL, MV

Fig. 6. Effect of intensity of ultrasonics on deposition potential

The schematic tabulation of Fig. 7 indicates an area just below the bright range with ultrasonics where deposits of the kind illustrated in Fig. 8 are formed which are not observed in a stationary bath. The surface shows scar-like or linear undulations which are not visible under the microscope. This shows that this attack is not due to pseudocavitation, which is not yet known to occur at the frequencies and intensities employed. The reader is referred to another paper<sup>8</sup> of the author for a possible explanation of this strange surface phenomenon.

At higher ultrasonic frequencies at which standing waves readily form, surfaces of the type shown in Fig. 9 may be formed.<sup>2,7</sup> The metal is preferentially deposited at the antinodes of oscillation. When the intensity is increased to several watts per square centimeter, pseudocavitation sets in and the cathode is attacked mechanically. Fig. 10 shows an example of such cavitation attack.

It would appear from these experimental results that frequencies best suited for electroplating with ultrasonics would be those between 20 and 50 kc., at which standing waves can be relatively easily pre-

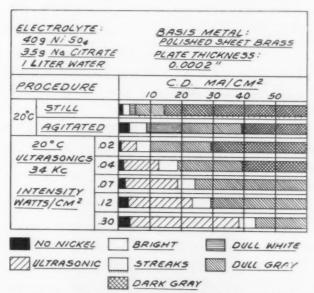


Fig. 7. Appearances of nickel surface under various conditions of deposition.

vented. The intensity must not exceed a certain limit as it is well known that pseudocavitation occurs at lower levels of intensity with lower than with higher frequencies. The most favorable intensity may be assumed to be between 0.3 and 0.5 watt/cm.<sup>2</sup>.

Referring again to the appearance of the deposit, it should be added that it is practically free of porosity when deposited with ultrasonics. Without gas bubbles clinging to the cathode, the deposit is of uniform thickness throughout. This may be of interest for the plating of some noble metals since small bubbles, particularly, tend to adhere even with normal cathode agitation and may cause pore formation. The above discussion has shown the superiority of ultrasonics over mechanical agitation of the electrolyte and its powerful effect on gas bubbles.

Fig. 11 indicates the effect of ultrasonics on the structure of deposited metal. Under the given conditions silver is deposited in fine-grained radial crystals which grow at right angles to the basis metal surface. With ultrasonics, the structure becomes coarser and twins are formed. The same coarser structure is also obtained when the electrolyte is strongly agitated during electrodeposition. Ultrasonics again, as with the electrochemical effects, show similarity with agitation. Improvement in the adhesion of the deposits by ultrasonics could not be observed in any case. The example of Fig. 11 shows no indication of intimate mechanical interlocking with the substrate, or of diffusion.

X-ray pictures produced by penetration or reflection methods do not reveal differences between deposits produced with and without ultrasonics of the low intensities used. It has not yet been possible to determine with certainty whether any change in hydrogen content of the electrodeposited metal is caused by ultrasonics. It would appear improbable because no effect was found in a large series of hardness measurements on nickel deposits produced over a wide range of conditions.<sup>9</sup>

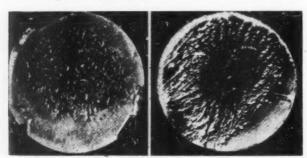


Fig. 8. Ultrasonics attack on electrodeposited nickel.

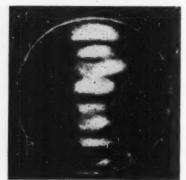


Fig. 9. Silver deposit from a potassium cyanide bath. Current density 20 mA/cm<sup>2</sup>. Ultrasonics of 560 kc./sec., 3 W/cm<sup>2</sup>.

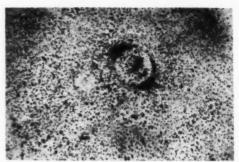


Fig. 10. Cavitation pitting in a bright nickel deposit.

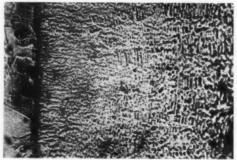
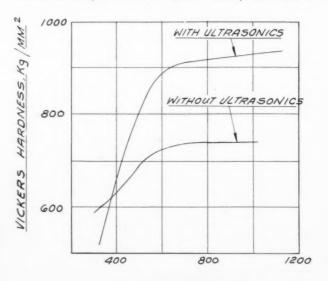


Fig. 11. Silver (approx. 0.004") deposited under varying conditions from a cyanide solution. Current density 20 mA/cm<sup>2</sup>.



C.D., MA/CM<sup>2</sup>
Fig. 12. Hardness of chromium deposits produced with and with-

This is contradicted by measurements made by Fr. Muller and G. Kuss.<sup>4</sup> Fig. 12 shows deposits made with ultrasonics to have an appreciably greater hardness. In these experiments the chromium was deposited on a cathode oscillating at 16 kc. at right angles to its surface. As no further details are furnished in the paper, a comparison with other measurements is difficult. The same authors have also found an increase in the tensile strength of copper deposits under the influence of ultrasonics. Here again, the data are very incomplete so that they cannot be evaluated with certainty.

It would be interesting from a practical point of view to know the performance of alloy plating solutions which are commonly used in industry with noble metals. No information on the subject is found in

(Continued on Page 63)

## BARREL FINISHING

By Arthur S. Kohler, Frederick Gumm Chem. Co., Inc., Kearny, N. J.

This is the second installment. The first part of this article appeared in the August issue. — Ed.

#### Barrel Construction and Lining

Barrels used for metal finishing are constructed either of welded steel or cast-iron or, in the case of the small tubbing barrels, of rock maple. As far as wearing qualities is concerned for unlined barrels used for deburring, the cast iron barrel is probably preferable since the walls are generally about an inch thick and soon acquire a smooth polish which is quite resistant to wear.

The cast iron barrel is made in several sections and the sides are bolted to the rest of the barrel. While this type of construction is quite heavy, it requires no more power to operate than a welded barrel. Since this type of construction requires the use of a foundry and machine shop, many suppliers prefer the simpler welded steel type of barrel. However, it is a rugged barrel and quite serviceable.

Most deburring barrels are of welded steel and are made in one piece, or the sides can be made separately with flanges and bolted to the rim. The bolted type of barrel is often easier to line with rubber, since it can be opened for application of the lining.

Barrel linings were originally of rock maple, generally about 11/2" thick. Two types of construction are used; one is of regular wood cut lengthwise of the grain and slabs are cut to fit somewhat loosely against the sides. These are locked in place by the flats and finally the flat sections near the door are secured with screws to the walls of the barrel. This type of construction required considerable guesswork on the part of the carpenter to decide how much allowance should be made for expansion of the wood when it became water soaked. If the wood did not expand as planned, it was common for the sides to buckle and bulge. In some cases, the expansive force was sufficient to actually warp or rupture the barrel itself. A second type of construction uses rock maple which is cut across the grain. This forms a much better wearing surface and warping is largely eliminated. All wood linings require several days of soaking with water to swell the grain to its final size. Once the lining has been soaked, the lining should not be allowed to dry out or it may become damaged.

Maple-lined barrels are quite popular for ball burnishing, since the walls are resilient and do not cause peening of the work. The wood becomes quite slippery and clean and a very nice burnishing job can be produced in such barrels. If the barrel is not used steadily it may develop fungus growths which usually have unpleasant odors. A maple lining is good for 3-5 years of service in burnishing. After this time the wood becomes soft and punky and can be scraped with the finger nail. This type of lining is unsuited for deburring since the abrasive action wears out the lining, in some cases in a month's time. Furthermore, where a sequence of chemical treatments are used, the chemicals are absorbed by the wood or are held in crevices and carried into the next operation where the chemicals may have an adverse effect.

Most lined deburring barrels, at present, are lined with some variety of rubber. This lining is desirable because of wear resistance which is much greater than that of steel in deburring, and because many operators employ acid compounds or other chemicals which might injure the plain steel barrel. The lined barrel is resistant to all chemicals used in barrel work and has a reasonably long life expectancy in most cases.

Usually, where rubber linings are used, the inside of the barrel is sand blasted to form a clean, toothed surface; the surface is then coated with a bonding agent and the sheet rubber applied smoothly. Fillets are run along the corners to make a crevice-free long-wearing construction and the barrel is then cured in an oven at a high temperature. The rubber used must be properly compounded and cured for the proper length of time. Excessive curing or incorrect temperatures may cause a weakening of the rubber and poor life.

The lining of barrels is still in the development stage and the user has to depend on the skill and integrity of the man who does the lining. In general, the thickness of the rubber used is of importance both from

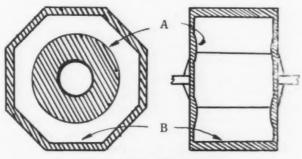


Fig. 10. Rubber Barrel Lining

the standpoint of wearing qualities and also the bonding of the rubber to the metal. Fig. 10 will help to explain these points. The area of maximum wear is a ring around the sides of the barrel (A — Fig. 10 shaded section). Some barrel lining suppliers make the walls thicker here than elsewhere if requested to do so. Section B around the periphery receives a constant series of blows which are particularly heavy in the case of castings. The rubber here should be thick enough so that the blows are somewhat spread out instead of being concentrated in a small area. This reduces the strain on the rubber-to-metal bond. For fairly heavy pieces, thicknesses of ½ to 1" are advisable here. The side walls may be ¼ to ½" or, if a thickened ring (A Fig. 8) is desired, this can be \( \frac{3}{4}\)" thick.

While the term rubber has been employed in those descriptions, it was used to cover various elastomers as well as natural rubber. Neoprene is frequently used for lining barrels, largely because of its oil resistance. Since, frequently, the work is not cleaned free of oil before being put in the barrel, this is a good reason for using neoprene. Actually the material has relatively poor abrasion resistance compared to other rubbers. However, natural rubber absorbs oil and, in time, develops a sticky black tarlike surface which may adhere to the work and be very difficult to remove. Where work is free of oil, the abrasion resistant rubbers have the best wearing qualities. The reported life of lining varies enormously and this is probably due to the great variety of work treated in the barrels. In most cases, abrasion resistant rubber linings should be good for 5-6 years, although, with heavy castings, linings may wear out in a year's time.

In recent years, there has been interest in the plastisol type of linings and it is claimed that such linings last twice as long as neoprene. Some of the large barrel using companies apparently have had good success with these linings, particularly on small sized barrels, and are using them more extensively. This type of lining is poured into the barrel which has been preheated to a definite temperature. The heat sets the plastisol to a definite thickness, depending upon the amount of heat retained in the barrel walls. The excess plastisol is then poured out and the barrel heat cured. While variations in wall thickness are limited this is not too important where the work is light and of moderate size.

#### Auxiliary Barrel Equipment

With the increasing importance of the tumbling barrel as a finishing tool, many companies now have well designed work spaces and suitable auxiliary equipment. Proper equipment and plant arrangement facilitates production handling, saves labor, and definitely fosters a better quality of workmanship.

Barrel deburring work is now much wider in scope and many jobs comprise two or more steps in the same barrel. This means changing the chemicals and compounds used, and parts have to be thoroughly rinsed between operations. As a result, fair amounts of water are required and, since residues and rinse waters are dumped directly on the floor, there is considerable splashing and deposition of grindings from

the operations. Consequently, the barrels should be located in such a place that they have good sewer and drainage facilities and also an ample water supply.

Probably the most satisfactory arrangement is to have a concrete floor which is pitched toward a drain trough located to the rear of the barrel line. The pitch should be a 3%-5% grade and, if possible, a low curbing should be added around the tumbling area to prevent possible sudden surges of water from flooding adjoining areas. The drain trough should be 6-12" deep and about 12" wide. This can be covered with subway gratings or duckboards. The trough should terminate in a shallow sump so that sludge, chips, etc., which find their way into the trough, are not carried into the sewer line. The sewer drain should be situated somewhat above the bottom of the sump and should have a wire strainer covering it to prevent trash, entering the sewer line. The sump should be shovelled out regularly. By using these precautions, danger of clogging the sewer is largely overcome. Some installations locate the barrels over shallow sumps covered with subway gratings. The drawback to this method is that parts or medium which may be spilled during loading either fall into the pit or catch in the grating. Furthermore, movement of the tote pans or gondolas is sometimes rather difficult because of the roughness of the gratings.

Duckboard walks in front of the barrels are a convenience in keeping the operators' feet dry. Canvas shields hung on two hooks in front of the barrels are good for preventing splashing of water during the tumble flushing operations.

Electric hoists are to be preferred over hand operated hoists if there are many barrels used in the tumbling room. These are employed for loading, transferring media to storage bins, separators, etc. The hoists should operate from a double rail crossbeam so that the pans can be moved three dimensionally in any part of the tumbling area. Monorails are not satisfactory because of limited, virtually two dimensional movement. Since the load in a pan may run from a few hundred pounds to half a ton or more, it is obvious that the overhead hoist system must be adequate structurally and good quality rollers should be used.

The water line in most cases should be at least 1" hose for large barrel sizes to avoid wasting the operator's time when filling the barrel or rinsing. The ½" lines sometimes used are too slow even for medium sized barrels.

Perforated doors used for tumble flushing may conveniently be equipped with hose doors so that the water may be run directly through the door without the added labor of removal of the door.

Electric push button switches for operation of the barrel should be conveniently located on the barrels, and individual switch fuse boxes should be located nearby so that the current can be completely cut off from the barrel while making repairs.

Storage bins for media should be located at the side or in some other convenient location so that they do not interfere with the production area. Most installations use several sizes and types of media which must be stored when not in use. Two often the bin space is skimped or completely omitted when the

plant is designed and operators are hampered by this lack. Furthermore, the storage of medium in miscellaneous drums, boxes, etc., needlessly increases accidents. It is well to allow more, than less, bins when planning alterations or a new installation.

The most common type of separator, particularly when working with crushed chip type of media, is the mechanical shaker screen. The screens serve a dual purpose, to separate work from the medium, and also to regrade worn undersize medium. Usually such screens are suspended on coil springs and are operated by a cam or crank mechanism driven by an electric motor. Many shakers are supplied with not much more than a frame and screen. The purchaser then adds home-designed hoppers, etc., as required. Others are provided with hopper feeds, and some are so arranged that the loading pans can be set on a tilting platform which has a self-contained feed gate. The pan is set at any desired angle and the feed gate adjusted to regulate the flow of the load onto the shaking screen.

Where small barrels are used, often the maintenance department builds small sieves which can be shaken manually. Such sieves generally slide in tracks or are suspended on chains over a receiving box or hopper and the work is slowly poured onto the screen. This is quite satisfactory in many cases, and is generally used with burnishing balls since the balls run

through the screens very easily.

Magnetic separators are sometimes used when the work is magnetic and the medium is not. One deterent to this type of separation is that much of the aluminum oxide media is partially magnetic and clean separations are not always obtained. Furthermore, irregularly shaped parts often cling in clusters to the magnet and enclose some of the medium in the mass, even though the medium is non-magnetic. This, again, interferes with complete separation. In cases where the magnetic separator can be used, it is a rapid, convenient machine. Several types are employed. The simplest type has a magnetic drum which slowly rotates on its axis. The mixed load is fed from a hopper down the side of the drum which is moving downward. The non-magnetic material drops straight down from the drum into a catch box while the magnetic parts are carried around the drum and part way up the opposite side of the drum where they are scraped off and dropped into a separate box.

Another design (Fig. 11) feeds the load from a hopper onto a moving belt where the load is distributed in a thin layer. The load is passed under a magnetic pulley, which picks up the magnetic work and carries it on a belt upward over the pulley. The belt separates the work from the pulley, passes it through a demagnetizer and discharges it into a tote box.

Some loads are spread on a table and operators separate the work pieces by hand or with small hand magnets. Hand separation is quite common where the pieces are large and relatively few in the barrel.

#### Tumbling Media

A tumbling medium is required in most cases for several purposes:

1. To fill the void spaces between the work pieces.

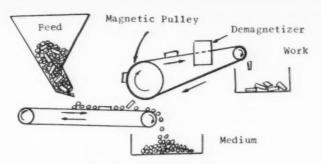


Fig. 11. Magnetic Separator

When irregularly shaped pieces are tumbled without medium in a barrel, there is a tendency in some cases for the pieces to form clusters. When this occurs, the load does not tumble freely and smoothly and, often, the more fragile parts or projections are bent or broken. Also, when moderately heavy pieces of irregular shape are tumbled without medium, the parts collide and become severely bruised. The medium then, by keeping the work pieces apart, serves as a cushion to prevent or lessen damage between parts.

- 2. Since the medium constitutes the greater proportion of the load, it imparts its own characteristic to the tumbling mass. If the pieces of the medium are large and irregular in shape, the load as a whole is more rigid in nature and the action is more vigorous. When the particles of medium are small or sphere-like, the load is more fluid, the action is gentler, and there is less chance of damage to the work. Also the tumbling time to achieve a given result is greater.
- 3. If the medium is a cutting type such as aluminum oxide, it provides grinding action. If it is smooth and very hard, it burnishes. Thus the choice of medium often determines the type of result obtained.
- 4. The medium may be chosen over a large range of sizes so that it can reach all significant surfaces and edges which might not be reached were the parts self-tumbled. Thus, the medium transmits and distributes the mechanical action to all accessible surfaces.

Over the years, almost every conceivable type of material has been tried as a barrel tumbling medium and, gradually, certain definite types have been found to have merit and have become established in practice. Most of these can be classified in kind and purpose.

Two general classes of form are available commercially. One class consists of irregularly shaped crushed materials. In this group fall all of the natural stones or synthetic materials which are not exactly uniform in size and shape. Usually, these materials are crushed in mills and then tumbled in barrels to remove excessive sharpness and to bring them to roughly egg-shaped pieces. They are then screened through a series of sieves to produce "average" sizes. Due to the irregularity of shapes, long slender pieces may often be found mixed with nearly round or thin flat pieces which may differ considerably in weight from piece to piece. This type of material is usually the cheapest and, for many jobs, is entirely satisfactory. However, where work being tumbled contains

slots or holes, this type can be very troublesome due to medium lodging in these recesses. As a result, in these instances, the medium has to be carefully selected as to size and frequent regrading of size may be necessary to prevent the trouble of hand picking the medium from the slots.

The second class consists of a medium in which the particles are all of the same size and shape. In this group fall metallic media such as burnishing balls and shapes, steel and zinc shapes and also molded ceramic and plastic shapes of one kind or another. These, because of uniformity of size, are often needed for specific jobs. Such shapes may be in the form of spheres, pins, flat discs, diagonals, cones, flat triangles, etc.

#### Composition of Media

#### ALUMINUM OXIDE:

This type is generally used for heavy deburring, particularly on steel parts. The medium is available as the fused electric furnace product, or it may be a natural mined material or, in other cases, it may be ground to a fine powder, mixed with a ceramic binder and baked to a hard, dense, uniform product. In most cases, these three basic types are crushed, tumbled, screened, and sold in this form. In some instances the ground powder mixed with the ceramic binder may be molded into definite shapes before baking.

Aluminum oxide is a tough, hard, abrasive material with good wearing qualities. Because of its intrinsic abrasive action it often can be used with non-cutting types of compounds. It is well adapted to use for deburring and, in the larger sizes (½" and larger), is used for rough cutting of sand castings, forgings, steel stampings, etc.

#### LIMESTONE:

This material varies considerably in properties and, probably, the product differs from mine to mine. Certain mines yield materials which are well adapted to use in certain barrel tumbling work. The grades used have a mild cutting action (sometimes called a "honing" action). It is comparatively gentle in its cutting action and, since its sharp edges quickly grind down and become fairly smooth, it is often used with some of the softer metals such as brass and zinc. It is mildly alkaline, due to its calcium and magnesium carbonate content, and is not well suited for use with acid compounds. When used with compounds containing regular soap, a coating of calcium and magnesium soaps forms on the surface, which greatly reduces the cutting qualities. In some instances, this reduction in cutting action is desirable, since it tends to produce a smoother, more burnished type of finish. Sometimes limestone is used with abrasive compounds to enhance its cutting action. It is low in cost, although its wearing qualities are not very good.

#### GRANITE:

This material has little abrasive action in itself. If it is tumbled with a non-abrasive compound, it rapidly becomes polished and its principle action is then one of peening rather than grinding. Where deburring action is required, it must be used with an abrasive-type of compound. It is low-priced and has fair wearing qualities.

#### CERAMIC:

This is a porcelain type of material, and is generally molded into definite shapes such as triangular plates, conic sections, spheres, etc. It has little cutting action in itself and glazes readily when tumbled with a non-cutting or burnishing compound. When used with abrasive compounds, it can be used for all metals.

#### OTHER NON-METALLIC DEBURRING MEDIA:

Flint pebbles are similar to granite in performance and glaze readily unless used with abrasive compounds. Molded abrasive slugs using a neoprene binder instead of a ceramic binder are soft and conform to the shape of the parts being tumbled, so have better action on surfaces than the harder media, but less action on edges and corners. Due to the softness, resilience, and moderate density, they are less liable to damage the more fragile work. Quartz, honing stones, similar in composition to slipstones used in sharpening steel tools, have fine cutting action and do not tend to glaze when used with suitable compounds. Blue Stone has been used to some extent but has poor cutting qualities and is generally inferior to the other media.

#### BURNISHING SHOT:

This consists of case hardened, highly polished balls, diagonals, pins, etc. These are used exclusively for ball burnishing and, when properly handled, will produce the highest luster obtainable in the tumbling barrel. They are not used with abrasive compounds nor are they suited for deburring and grinding; they are used only with burnishing compounds or soaps. Since the final brilliance given the work pieces depends, in a large part, on the brilliance of finish on the surface of the burnishing shot, it is necessary to take good care that the burnishing shot is properly stored when not in use and that it is used with compounds which do not damage the surface by allowing rusting to take place. In storage, the work may be kept in steel barrels, completely covered with an alkaline cleaning solution. This permits storage for a few weeks' time. If the work is to be stored for longer periods, it may be rinsed well and dipped in a water displacing rust preventative. If well dried, the work can also be dipped in oil for storage, although the rust preventive is simpler to use and is more effective.

#### METALLIC DEBURRING MEDIA:

Metallic slugs used for deburring are generally of zinc or soft steel. Zinc being quite soft and resilient can produce fine finishes on surfaces and is often used where extremely fine finishes (1-5 micro inches) are required on hardened steel parts. Due to the fact that the soft metal tends to conform to the shape of the surface of the work, it is very effective for smoothing surfaces. Soft steel, being harder than the zinc, is not as effective in surface smoothing, but still gives a high quality surface in many instances. Both materials must be used with abrasive, deburring or polishing compounds, and the abrasive becomes impregnated in the surface of the soft metal, exerting a grinding or polishing action as the slugs slide over the surface of the parts. Most of the available metallic

slugs are sold in uniform shapes such as diagonals, flat discs, etc. These are available in a series of sizes. Sometimes small scrap steel punchings are used and may be suitable for some jobs.

#### Compounds Used in Barrel Finishing

The compounds discussed here are all designed for use with water as a vehicle and may be used in quantities ranging from about 1 oz. per gallon of water up to 1 or 2 lbs. per gallon in the case of abrasive deburring compounds. Generally, where low concentrations are used, the material is a non-cutting compound, its action is chemical in nature, and the load in the barrel is covered with water. The abrasive type compounds use relatively little water, often just sufficient to form a thin slurry or creamy suspension of the abrasive compound. Since compounded materials contain a number of substances which have cleaning action, chemical buffering action, possibly rust preventive action, etc., it is usually more satisfactory to use compounds from a dependable supplier rather than to use raw chemicals.

#### CUTTING-TYPE COMPOUNDS:

These consist of abrasives mixed with chemicals which are designed to maintain the proper chemical conditions for deburring, honing, or polishing. As a general rule, the coarser materials are more rapid in action than the finer abrasives, but leave a rough matte finish on the metal. The abrasives used differ in hardness and wearing qualities, and are ground finer as the deburring continues. Different types are used in deburring work, depending on the results required and the length of the tumbling time. For long deburring operations a hard, long-lasting abrasive is used which maintains its cutting action for a long time. In other cases, particularly with the softer metals, a softer type of compound is used which breaks down fairly rapidly. This is an advantage in many cases, since the cutting action can be regulated to give rough cutting initially and finer cutting later. Even the hardest abrasives lose a good part of their cutting action after 12-15 hours of use, and it may be necessary to replenish the compound after this length of time. Where parts are self-tumbled or deburred with metallic media, the abrasive supplies all of the cutting action. When used with stones that tend to glaze, the abrasive keeps the surface of the stones roughened so that the surface continues to cut. In order to have the abrasive roughen the surface of the stones, it is essential that the abrasive be at least as hard as the stone itself. Abrasive compounds are also used to some extent with aluminum oxide medium to increase its cutting action. The rate of attrition of the abrasive depends on its composition of the material and also, to some extent, on the size or hardness of the deburring medium; the larger and harder media causing the more rapid breakdown of the abrasive.

#### CLEANING COMPOUNDS:

These are usually mixtures of alkaline salts, with or without the addition of organic detergents, soaps, etc., and sometimes rust or tarnish inhibitors. They are generally used for the removal of dirt and oil, or for deburring parts with an abrasive medium.

#### SHINE ROLLING COMPOUNDS:

These are similar to the cleaning compounds but, in addition, they contain lubricants and protective colloids. They are generally used for self-tumbling parts, to remove dirt and oil, to allow peening to reduce edge sharpness while developing a bright clean appearance on the metal. Parts are often barrel plated directly after shine rolling and rinsing.

#### BURNISHING COMPOUNDS:

These are usually mildly alkaline mixtures containing relatively large amounts of soap and other detergents in many cases. They have excellent lubricating action and may be used with stones which glaze readily or with burnishing shot. Compounds of this general type are also used with limestone medium where the soap reacts with the limestone to form an insoluble metallic soap coating on the limestone. This reduces the cutting action and changes it to more of a burnishing action and the work acquires a bright finish.

#### DESCALING COMPOUNDS:

Generally, these are acid powders which may contain detergents, inhibitors, accelerators, etc. They are used with self-tumbling parts or with medium for removing scale and rust. They are also used after deburring to restore a clean bright color to the parts. Whenever these compounds are used in a closed barrel, it is important that the barrel be properly vented and that flames be kept away from the barrel when it is first opened, since hydrogen gas is usually given off and could easily cause a serious explosion.

#### (To Be Concluded Next Month)

#### THE EFFECTS OF ULTRASONICS

(Continued from Page 58)

the literature. From the known experimental results, it may safely be predicted that the deposition potentials of the various metal ions in the bath will shift because of the agitation effect of ultrasonics and that the composition of the alloy plate will, therefore, differ from that of metal deposited from a stationary solution. It does not appear impossible that alloy plates may thus be produced which so far have not been capable of deposition from a stationary solution. No positive statement, though, can be made without special systematic experiments.

The author's investigations were performed upon the initiative and for the account of Württembergische Metallwarenfabrik, Geislingen/Steige. The author wishes to express his gratitude particularly to *Dr. A. Burkhardt*.

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## **Finishing Pointers**

#### **Bath Concentration Units**

By J. B. Mohler

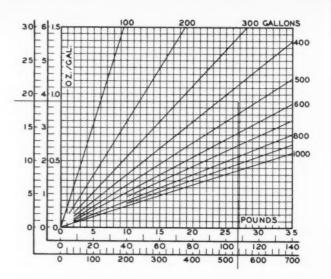
A PRODUCTION plater once observed that electrolytic cleaners always come out to 6 oz./gal. This is not an invariable recommendation, but it is common for cleaners of this type. Why is this so? It is probably because 6 is a nice round number. There would be little difference in the efficiency of 5, 6 or 7 oz./gal. Therefore the original choice was probably for 4, 6 or 8 and 6 turned out to be sufficient without being excessive. Also, the choice was made in ounces per gallon because these units of concentration are widely used and recognized. A nice round simple number in common units is readily accepted. This is as it should be.

Take another example. Chromium plating baths are specified as 250 g./l. or 400 g./l.  $CrO_3$ . These are even multiples of 50 to 100 and thus are convenient numbers with which to work. Unfortunately, the plater usually works in oz./gal. so these baths turn out to be 33.3 oz./gal. and 53.3 oz./gal. Actually one can work with 30 oz./gal. and 50 oz./gal. for these two baths and there will be very little difference in plating characteristics as compared to the concentrations commonly given (providing the  $CrO_3/SO_4$  ratio of 100 to 1 is maintained).

In the case of the cleaner, 6 oz./gal. = 45 g./l. If one preferred to work in grams per liter this could be rounded off to 50 g./l. This sort of thing can be done in converting from one system of units to another. However, it should not be done without considering the importance of chemical concentrations. A change in the excess of free cyanide in a copper strike will markedly change the cathode efficiency. A change in the free caustic concentration in an alkaline tin bath will decidedly affect anode solubility. Changes in concentrations of various chemicals in a Watts nickel bath can completely change the characteristics of the bath.

Original experimentation is often done in grams per liter, recommended in ounces per gallon. All one has to do is use the proper conversion factors to work in any system.

There is no best system for concentration units. It is all a matter of what one wishes to do. For experi-



mentation and calculations the metric system is convenient simply because it is a decimal system and one can convert from milligrams to grams to kilograms or from milliliters to liters merely by moving the decimal point. The system of pounds and ounces is good where one purchases material and weighs it in such units.

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There is a unit of concentration that is not widely used because it is not commonly known. This is ounces per cubic foot. It just happens that 1 oz./cu. ft. equals almost exactly 1 g./l. One oz. = 28.25 g. One cu. ft. = 28.32 l. Therefore 1 oz./cu. ft. = 1.001 g./l. or for all practical purposes 1 oz./cu. ft. = 1 g./l. Experimental work and analyses may be carried out with the conveniences of the metric system and common laboratory equipment. Numerical results can be applied directly in terms of ounces and cubic feet.

Tank volumes are measured in feet and inches and calculated as cubic feet; then the cubic feet are converted to gallons. A step can be saved by working directly in cubic feet. Chemicals are weighed in pounds, and ounces are converted to pounds by dividing by the well known factor of sixteen.

We are always in a hurry to calculate a chemical addition for a tank converting from oz./gal. to lbs./gal. to lbs./gal. to lbs./tank. It is worthwhile to calculate the factor 1 oz./gal. = X lbs./tank once and for all. Better yet a simple graph of oz./gal. vs. lbs. per tank can be read directly. Every step that is eliminated saves time and reduces the possibility of an error. It is these many simple things that increase accuracy and take the work out of routine control.

As an illustration, the graph is given to show how a few lines can be used to read the pounds to add for any tank size from the concentration desired in ounces per gallon.

#### Example

for 0.95 oz./gal. and 450 gallons add 26.8 pounds for 3.8 oz./gal. and 450 gallons add 107 pounds for 19 oz./gal. and 450 gallons add 535 pounds.



## Science for Electroplaters

#### 28. Treatment of Chromate Wastes

By L. Serota

#### Precipitation

ACID wastes in which chromium is present in the hexavalent form, such as the chromate ion, together with other heavy metals including trivalent chromium, require special treatment, since the chromate anion cannot be removed, as the corresponding hydroxide, by precipitation with alkalies. Chromates are introduced in waste waters from the following plating room operations: chromium plating of metals, anodic oxidation of metals, preparation of surface metals before electroplating, and chromate conversion treatments. Such waste water is usually acidic, yellow in color and will include sulfuric acid as well as the metal ions zinc, copper, aluminum, and nickel. Considering the extreme toxicity of the chromate ion, adequate treatment of waste for its removal is important.

Methods employed for removal of hexavalent chromium (chromate ion) may be grouped under the following general classifications:

- 1. Direct precipitation, as an insoluble salt, of chromic acid or a chromate.
- 2. Reduction of hexavalent chromium to the trivalent form with a reducing agent in an acid medium. The reduction is followed by treatment with an alkali. Chromium hydroxide, Cr(OH)<sub>3</sub>, will thus precipitate. Reducing agents used include sulphides, bisulphites, hydrosulphites, metabisulfites, ferrous sulfate, sulfur dioxide, zinc dust (or zinc alloy, such as brass), scrap iron.
- 3. Removal of the chromate ion from the waste waters by the ion-exchange (or adsorption) method.

The fact that some chromate salts, such as barium, lead or silver, are but slightly soluble in water under alkaline or neutral conditions serves as the basis for treatment, by precipi-

tation, of waste water containing chromates. This method, used in England and reported by J. Grindley, entails the addition of a large excess of a suspension of witherite, a practically pure natural barium carbonate, to the chromate wastes. The witherite acts as both a neutralizer and precipitation agent. Precipitation of barium chromate or sulfate upon the addition of the suspended witherite is based upon the difference in solubility of these very slightly soluble barium salts. Although the solubility of barium carbonate is only 2.2 parts in 100,000 parts of water, it is more soluble than barium sulfate (solubility 0.24 parts per 100,000 parts of water). Agitation of the mixture for about one hour by means of compressed air will result in barium carbonate going into solution while the less soluble compounds. barium chromate and barium sulphate. are precipitated. Complete precipitation of the chromate in waste water was reported obtained for concentrations ranging from 20 to 78 ppm. of chromium. The pH of the treated waste water ranged from 6.9 to 7.4 A 12 hour settling period is allowed before discharge of the effluent. If the waste water contains heavy metals, a lime treatment must follow for precipitation of the metals as hydroxides. This process, it is claimed, can be operated by unskilled labor, whereas the addition of a soluble barium salt, as the chloride, followed by lime for precipitation of the chromates, requires greater control because of the possible discharge of these toxic materials in the treated waste water.

#### Sulphide Reduction

Chromate waste treatment at the Electrolux Corp., Old Greenwich, Conn., plant, described by M. E. Hodges, is an interesting example of one of the earliest (1939) industrial applications for such procedures. Al-

though barium sulphide was originally selected as the reducing agent, subsequent study of the problem, owing to difficulties encountered with this reducing agent as well as the desire for a more economical treatment method, led to the substitution of sodium metabisulphite, the process in use now.

The reaction with barium sulphide. a relatively cheap reagent obtained as commercial barium black ash, when used as the reducing agent for chromium in the waste waters, was carried on at the lowered pH of approximately 2.0. Sulphuric acid was used to reduce the pH. Ground barium sulphide was then added and mixed into the solution for about 2 hours, followed by the addition of hydrated lime until the pH of the mixture was above 7.0. The sludge which forms consists, according to B. F. Dodge, of a gelatinous chromium hydroxide and a more crystalline barium chromate. The volume of this sludge is smaller than that obtained with other reducing agents. Settling time was one hour before the clear supernatant liquor was decanted by means of an adjustable standpipe in the bottom of the tank. The sludge was filtered and the press cake hauled to a dumping ground. The following equations are given for the reaction:

$$\begin{array}{c} BaS + CrO_3 + H_2O \\ \rightarrow BaCrO_4 + H_2S \\ BaS + H_2Cr_2O_7 \\ \rightarrow BaCr_2O_7 + H_2S \end{array}$$

It was found that, with a waste water containing 75 ppm. of chromium, good results were obtained by reducing the pH to 2.0, then adding 5 to 6 pounds of barium sulfide per 1,000 gallons of waste liquor. About 4 pounds of lime were required per 1,000 gallons waste to raise the pH to 7.0. Treatment difficulties involved the need of grinding the barium sulphide in a closed room with an exhaust system to prevent the black dust from coating surrounding equipment and plant area. Hot water (65°C.) was necessary to dissolve the sulphide. Some sulphide was lost as hydrogen sulfide through hydrolysis. The unpleasant odor of this gas was present much of the time. In addition to these problems, supplemental treatment with other reducing agents was occasionally necessary for complete removal of hexavalent chromium.

By 1950 the volume of plating room waste at this plant had increased to about 160,000 gallons per day and reversion to sodium metabisulphite (also known as anhydrous sodium bisulphite or A.B.S.) provided a satisfactory substitute for the undesirable features of the barium sulphide (black ash). This salt (A.B.S.) is clean, white, easily dissolved and practically odorless. The solubility is such that it can be added directly to the treatment tank, thereby eliminating the need for a dissolving tank. The equation for the reaction is as follows:

$$3Na_2S_2O_5 + 4CrO_3 + 4H_2SO_4 \rightarrow 2Cr_2(SO_4)_3 + 2Na_2SO_4 + 2NaHSO_4 + 3H_2O$$

Reduction is rapid and requires a pH of 2.0 to 3.0. An average of 1.5 pounds of sodium metabisulphite were used for every 1000 gallons of waste liquor. Hydrated lime can be added within 15 minutes to raise the pH above 7, whereupon chromium and other metal hydroxides precipitate. Settling time is 0.5 to 1.5 hours and sludge volumes are smaller than that obtained by other treatments. The following chart, Table I, indicates the effectiveness of this reducing agent for converting hexavalent chromium to trivalent chromium.

TABLE I.

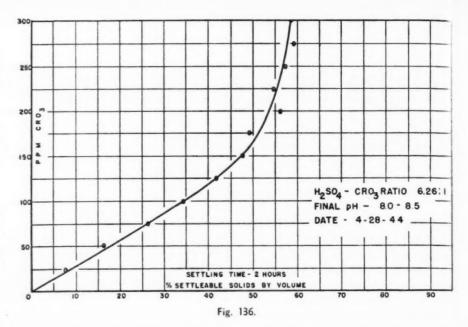
Typical Chart Showing Chromium
Reduction With A.B.S.

Samp		w Composit	Treated Composite					
		Chromium	Nickel	pH		m Nickel		
1	3.9	28 PPM	112 PPM	6.5	0 PPM	4.6 PPM		
2	5.15	25	84	6.95	0	5.6		
3	4.75	19	120	7.98	0	0.7		
4	6.5	31	27	8.0	0	10.0		
5	6.12	26	23	9.4	0	.0		
6	6.38	47	21	8.47	0	2.4		
7	5.58	29	18	10.0	0	1.5		

The same reducing agent (A.B.S.) was used satisfactorily for the treatment of (chromium) plating room wastes at the Lockland, Ohio, plant of the Electric Autolite Co. The ease in handling, on a continuous basis, with dry-feed machines, was considered of sufficient advantage to justify its choice over slightly less expensive reducing agents such as sulfur dioxide and ferrous sulphate.

#### Ferrous Sulphate Reduction

Chromate wastes at the Kaiser-Frazer plant at Willow Run, Mich., were treated with ferrous sulfate, at a pH of about 4, with a ratio of 5 ppm. of ferrous sulfate per 1 ppm. of chromic acid. The quantity required was determined by titration. When copperas (the heptahydrate of ferrous sulphate) is used, the ratio is



about 9 parts of copperas per part of chromic acid. Reduction of the chromium in the waste water was followed by neutralization, in flash mixers, with lime. The metals precipitate as hydroxides above pH 7 together with calcium sulfate. Settling took place in sedimentation tanks. The sludge was pumped to lagoons and the effluent discharged.

The Talon Inc. plant at Meadville, Pa., according to B. F. Dodge, used ferrous sulfate as a reducing agent for the treatment of acid-chromate wastes in a supplementary manner. The initial chromate reduction action was accomplished by having the metal waste flow over beds of scrap iron turnings and borings. The reducing action in this process was also followed by treatment (neutralization) with lime. When the pH was brought up to a value of 8.4, the cyanide wastes were introduced and the precipitated metals separated in a sedimentation tank. The sludge was pumped to drying beds and the clear effluent sent to the sewer. The equipment in the feed-room for dry chemicals in this plan was designed to treat 100,000 gallons of wastes including acids, metals, chromates and cyanides. J. Grindley reported that, for tests with water containing 24 ppm. chromium, reduction of the chromate ion by scrap iron treatment for a period of 4 hours gave residual concentrations of 4.3 and 2.0 ppm. chromium when the pH of the respective samples were 4.3 to 5.2 and 3.0 to 3.1, but only a trace of chromate remained unreduced after a 3 hour treatment period when the pH of the untreated water was 2.8.

Another example where the use of ferrous sulfate was found satisfactory as the reductant for chromium in wastes, is the Willow Run plant of the Ford Motor Co. Reduction was reported rapid at a pH of 2.5-3.0. Hexavalent chromium was found to be absent in the effluent from batches treated by this method. The sludge however was found to be of a voluminous nature and displayed poor settling characteristics. The graph, Fig. 136, obtained from data collected at this plant, indicates the volume of sludge compared to the per cent settled for different amounts of chromium following reduction with ferrous sulphate and neutralization with lime. M. E. Hodges reported that experimental runs with ferrous sulphate (copperas) as the reductant for chromate at the Electrolux plant indicated that the pH must be raised above 8.0 to precipitate all of the ferric hydroxide with chromic hydroxide. The volume of this sludge was up to 22 per cent. Failure to obtain a high pH resulted in poor color and clarity for the plant effluent. low

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Reduction of chromate to a chromic salt, by ferrous sulphate in an acid medium, is quantitative. It may be effectively shown by the following ionic equation:

$$Cr_2O_7$$
 --- + 14H+++ 6Fe++  
 $\rightarrow$  2  $Cr$  ++++ + 6Fe+++ + 7H<sub>2</sub>O

The complete equation becomes:

$$\begin{array}{c} K_2Cr_2O_7 + 7H_2SO_4 + 6FeSO_4 \\ \rightarrow Cr_2(SO_4)_3 + 3Fe_2(SO_4)_3 \\ + 7H_2O + K_2SO_4 \end{array}$$

Precipitation of chromic hydroxide from the chromic salt upon neutraliza-

tion with lime is indicated by the following equation:

$$\begin{array}{l} Cr_2(SO_4)_3 + 3Ca(OH)_2 \\ \to 2Cr(OH)_3 + 3CaSO_4. \\ Fe_2(SO_4)_3 + 3Ca(OH)_2 \\ \to 2Fe(OH)_3 + 3CaSO_4. \end{array}$$

The chromate ion is reduced to the trivalent chromium, the oxygen of this ion uniting with the hydrogen ion of the acid to form water. The ferrous ion from ferrous sulphate is oxidized to the ferric stage.

#### Sulfur Dioxide Reduction

A commonly used reducing agent for chromates in waste waters is sulfur dioxide gas, unless large quantities of ferrous sulphate are available from pickling plants. It is conveniently shipped in cylinders as liquid sulfur dioxide, is considered economical, and may be fed directly into the treatment tank. It has the advantage that the rate of addition is controlled by a single valve and it is delivered from the cylinder under its own pressure. A flow meter will indicate the constant rate of flow. Automatic controls are used with large units. Another advantage of sulfur dioxide use is that less initial acidity is required because the gas forms sulfurous acid when dissolved in water. The operating pH is generally 2 to 3 and the SO2 to CrO3 ratio used commercially is somewhat under 3:1. The ionic equation for this reaction is as follows:

$$Cr_2O_7^{--} + 8H^+ + 3SO_3^{--} \rightarrow 2Cr^{+++} + 3SO_4^{--} + 4H_2O$$
  
 $K_2Cr_2O_7 + 3H_2SO_3 + H_2SO_4 \rightarrow Cr_2(SO_4)_3 + K_2SO_4 + 4H_2O.$ 

A gas feed meter indicates the flow of sulphur dioxide required for this reduction. Control is a function of the oxidation reduction potentials of the trivalent and hexavalent chromium and is performed automatically.

The successful use of sulfur dioxide and brass chips for reduction of chromates in waste water on a pilot plant scale at the Waterville, Conn., plant of the Chase Brass Co., has been reported by B. F. Dodge. The waste liquor, following clarification by means of a sand (gravity) filter, is treated with sulfur dioxide, which partially reduces the chromate. Reduction is completed by allowing the waste liquor to flow over 3 beds of brass chips in series. Copper plates out on the brass during this process. Partial reduction with sulphur dioxide is necessary because the acid concentration in the TABLE II.—COMPARATIVE ANALYSIS OF ANODIZING SOLUTIONS

	Before Treatment	After Treatment
pH	. 1.2	0.6
Chromic Acid (CrO <sub>3</sub> )	. 7.36	7.34
Trivalent Chromium (as metal)	03	.0015
Iron (as metal)	09	.0005
Aluminum (as metal)		.0005

waste liquor is, at times, not high enough for complete reduction of chromium as well as displacement (removal) of copper by the brass.

#### Ion-Exchange Method

The development of ion exchange resins showing improved stability and resistance toward the oxidizing nature of chromic acid provides an effective method for the elimination of chromates in waste liquor. A number of such cation exchange resins now available make it possible to recover and re-use for plating and anodizing solutions a pure decationized chromic acid. Similarly, anion exchange resins are available for satisfactory recovery of chromium (as chromate ion) from rinse waters. The cost of chromium disposal in waste liquor is eliminated by the procedure, the loss of water is reduced, and a demineralized water is made available for re-use.

Cation exchange resins of the sulphonated polystyrene type will remove, principally, the metal contaminants aluminum, iron and trivalent chromium from anodizing solutions, and iron, trivalent chromium and copper from chromium plating solutions. The concentration of chromic acid in anodizing solutions is sufficiently low (70-100 g./l. CrO<sub>3</sub>) to permit direct treatment by cation exchange resins. The chromic acid in plating solutions (250-400 g./l. CrO<sub>3</sub>), however, must be diluted because the exchange resins are not resistant to the oxidizing action of such concentrations of chromic acid. Dilution to one pound chromic acid per gallon is recommended for safe treatment with one resin. The purified, diluted chromic acid is reconcentrated in an evaporator and returned to the plating tank. It has recently been reported that a new, heavy duty cation exchange resin can withstand decomposition, under oxidizing conditions, for concentrations of chromic acid up to 250 g./l. without dilution. The upper limit for previously used cation exchange resins had been 100-120 g./l., although L. Weisberg reported favorable results with a concentration of 150 g./l. CrO<sub>3</sub>.

L. Gilbert, in presenting comparative analytical data, Table II, for cation exchange treatment of 5000 gallons of spent chromic acid anodizing solution at the Rock Island Arsenal, Ill. (1951) indicated the removal of 99.8% of the aluminum, 99.5% of the ion and 95% of the trivalent chromium. The author expressed doubt concerning the accuracy of pH measurements for decationized chromic acid with a glass electrode. A study of cost of operation at this arsenal for a period of eleven months, during which time 9,950 gallons of chromic acid anodizing solution and 24,200 gallons of chromium plating solution were decationized, showed that the overall cost of operation (sulfuric acid, labor, steam, electricity, water, and air) was \$2,202.95. Since the value of the chromic acid solutions treated and recovered was \$17,958.75, a net saving for this treatment, deducting the operational cost, reaches the significant sum of \$15,755.80. Regeneration of the cation exchange is usually done with sulfuric

Recovery of chromic acid (chromate ion) from rinse water depends upon adsorption on a strongly basic, or quaternary amine, anion exchange resin. This method was adapted by the Channel Master Corp., in Ellenville, N. Y., for recovery of chromic acid in rinse water arising from the chromate dipping operation. Continuous operation is effected by using two anion exchange units. This permits regeneration of one while the other is in use. The resin is regenerated with sodium hydroxide, which yields sodium chromate. For conversion to chromic acid, the sodium chromate must be passed over a (hydrogen) cation exchange. The eluted chromic acid may then be re-used in the plating tank or, if required, after it is concentrated in an evaporator. A saving in regenerating chemicals and improved concentration of the recovered chromic acid

(Continued on Page 71)

### SHOP PROBLEMS

ABRASIVE METHODS SURFACE TREATMENTS CONTROL ELECTROPLATING CLEANING PICKLING TESTING



METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

#### Cobalt Plating

Question: We are interested in the use of cobalt for plating of metal parts and have recently learned that your publication METAL FINISHING carries an article concerning a method of doing this on page 68 of the September 1953 issue. We would, therefore, appreciate it very much if you could supply us with a tear sheet of this article.

L. K

Answer: The issue of METAL FIN-ISHING referred to in your letter does not have any information on cobalt plating. However, the following formula is commonly employed for the purpose:

Other formulas, together with operating conditions, can be found in the following references: Principles of Electroplating, by Blum & Hogaboom, McGraw Hill; Modern Electroplating, by Gray, John Wiley & Sons.

#### **Aluminum Coating Copper Wire**

Question: We are interested in finding information on the electro-deposition of aluminum to copper magnet wire and the subsequent anodizing of this aluminum coating to form electrical insulation qualities. We believe that a thickness of .0008 to .001" of aluminum and anodize to .0003" to .0005" would give us the desired qualities.

We also would like to know if you have any information on the coefficient

of expansion of this anodized coating and any effects of electrical insulation at temperatures of 1,000°-1,200°F.

J.B.

Answer: Aluminum can be electrodeposited only from fused salt baths or solutions of aluminum salts in organic solvent. It cannot be deposited from aqueous solutions and, because of the difficulty of controlling the organic baths and maintaining a closed system to avoid contact with air, the process has not been considered to be practical.

Aluminum is generally applied by hot dipping, although we are not aware of any application on copper wire. The coating is now produced by drawing down copper bar with an aluminum shell around it.

The coefficient of expansion of aluminum oxide is approximately one-fifth that of the metal, and the electrical insulating properties would not be affected at 1,000°F., although heating may result in cracks appearing in the anodized film.

#### **Stripping Chromium**

Question: We have been hard chrome plating electrotypes for a number of years with great success. These electrotypes have been either copper or nickel faced with lead as the back. One of our customers gave us a sample of a new electrotype which presents a little problem. The printing surface is nickel faced, backed by lead, a layer of plastic, and has a thin sheet of aluminum as its back.

If, for some reason, we should have to strip and replate one of these electrotypes, how would we strip the chromium off without attacking the nickel, lead or aluminum? We would appreciate any suggestions you may be able to give us.

R. R.

Answer: Chromium can be removed from these electrotypes without attack on lead, aluminum or nickel by employing reverse current at 4-6 volts in a chromic acid solution. If you have a reverse current etch of the chromic acid type which is used to prepare steel for hard chromium plating, this tank can be used for stripping. Otherwise, you can use a solution of 2 lbs./gal. in a steel tank with the tank as cathode.

Stripping by this procedure may result in a passive nickel surface which will not take replating, in which case reactivation may be required.

#### **Chromic Acid Anodizing**

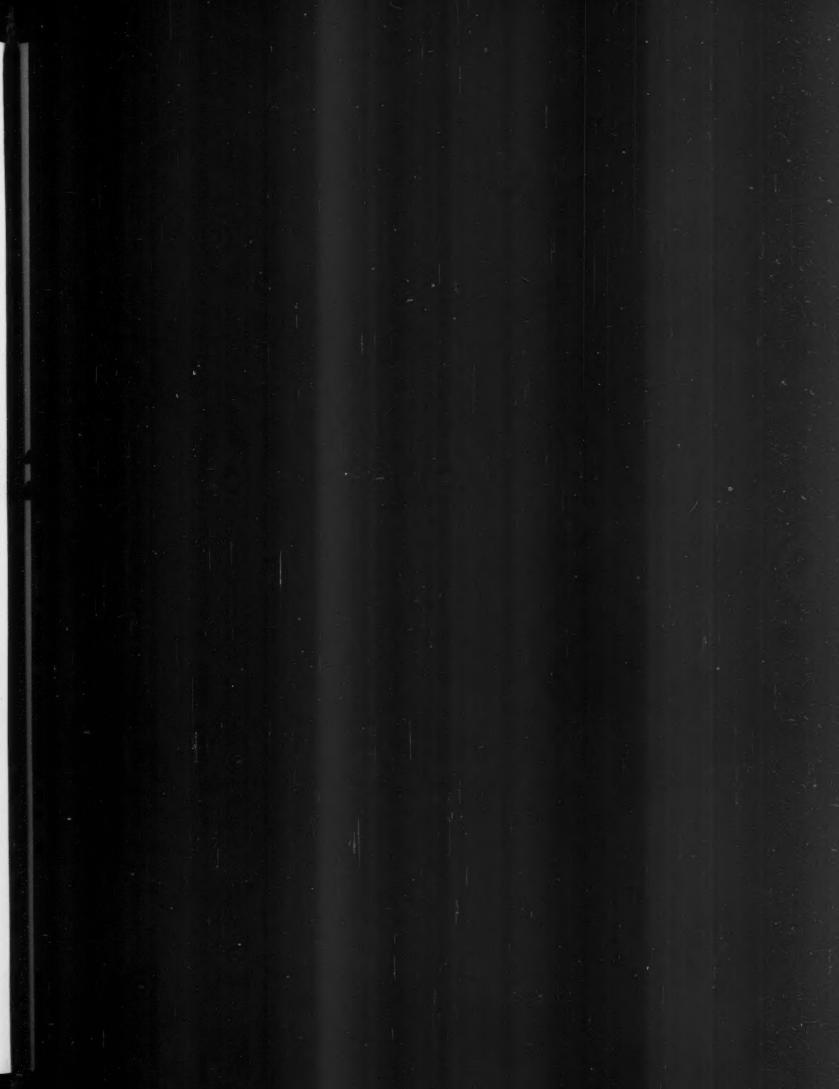
Question: We have a small chromic acid anodizing installation (180 gallon tank) which we use for both ordinary grey anodizing and for black dye anodizing. It has occurred to us that it might be desirable to make additions of chromic acid automatically, if the necessary equipment could be installed at a low enough cost. Do you know of any manufacturers of such equipment?

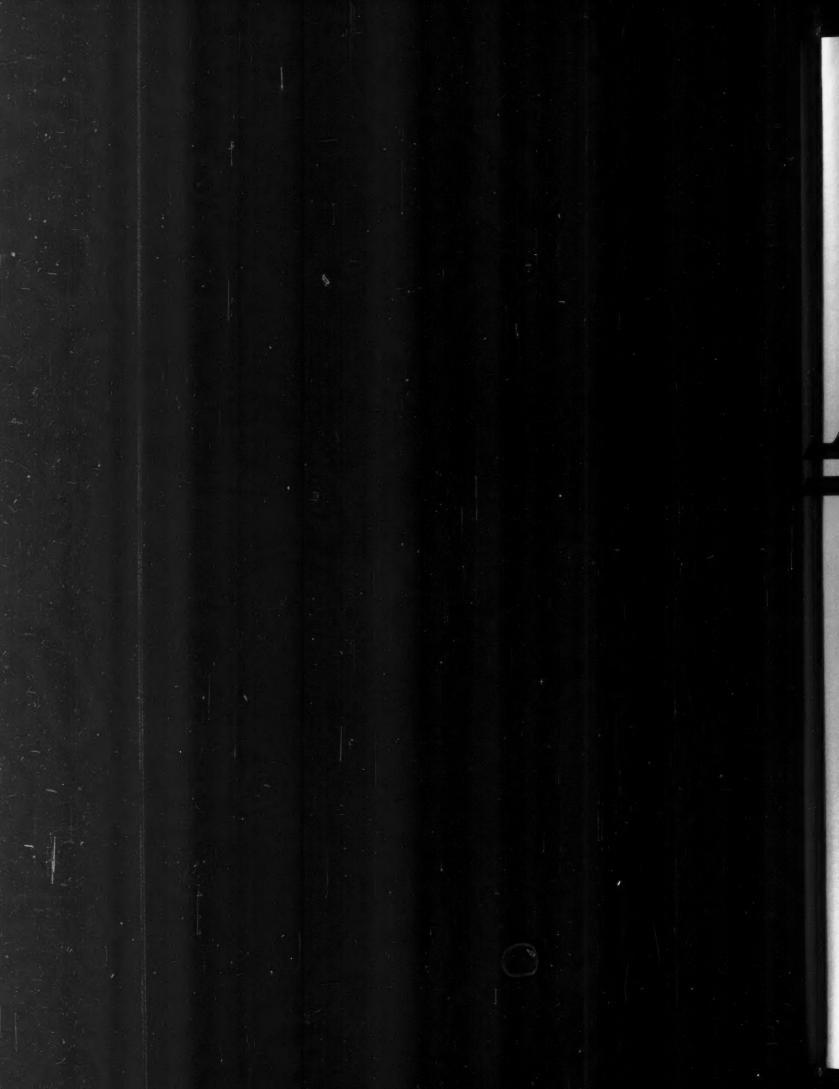
We are aware that the preferable method is to use an ion-exchanger but our information seems to indicate that this is too expensive for such a small installation.

K. F. C.

Answer: Maintenance of a chromic acid type anodizing solution for aluminum at 5-10% concentration ordinarily requires removal of solution and replacement with water, in order to maintain the pH below 0.85 electrometric with chromic acid additions.

If operation is started with a 5% bath, chromic acid solution could easily be added automatically to maintain the pH at the required maximum, by employing a pH controller and solenoid valve. However, when the total chromic acid content reaches 100 g./L., further additions cannot be made





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# Liquimatic

THE AUTOMATICALLY APPLIED

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HANSON-VAN WINKLE-MUNNING COMPANY MATAWAN, NEW JERSEY

# iquimatic compound

### How and why it saves time, saves money—and does a better finishing job—any job—on all metals!

Liquimatic Compound works by the "heading-up" principle. The compound is pushed against the work by the buffing wheel. What happens when the compound goes to work on the metal is almost like magic. The outstanding heading-up properties of Liquimatic Compound make it able to take the heaviest cuts, fast. Yet, it can be "toned down", easily. Viscosity can be controlled to suit any application, including extreme high-color work. Whatever the job, the compound does the actual work-not the buff. And it lubricates as it cuts. This, naturally, saves buffs. In fact, 200% savings in buff life have been reported . . . and that's not a bit unusual for Liquimatic users.

There are plenty of other savings, too. There's never any waste with Liquimatic. You use just what you need for the job. No nubbins or re-melt, as with bar compounds. Saves material. No changing of bars by hand. Saves production-killing downtime.

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Liquimatic is non-settling and has a very long storage life. You can store it almost anywhereeven temperatures down to the freezing point won't affect it. Let it come back to room temperature and it's good as new.

Liquimatic is non-plugging, thereby offering continuous operation with no interruption of spray after downtime periods.

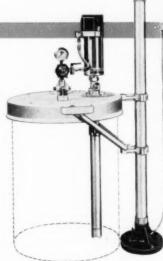
# Ciquimatic

Simple, easily installed automatic application equipment with exclusive metered master control assures economy, efficiency, uniformity.

Three simple basic elements form the Liquimatic automatic application system: the pump, the master control, and the spray guns. The heavy duty, longstroke, air-actuated pump is specially engineered for smooth, failure-proof delivery of abrasive liquids. It has a built-in pressure regulator and gauge, and it can be adapted for 30 or 50 gallon drums. An air operated pump elevator for easier drum replacement is also available.

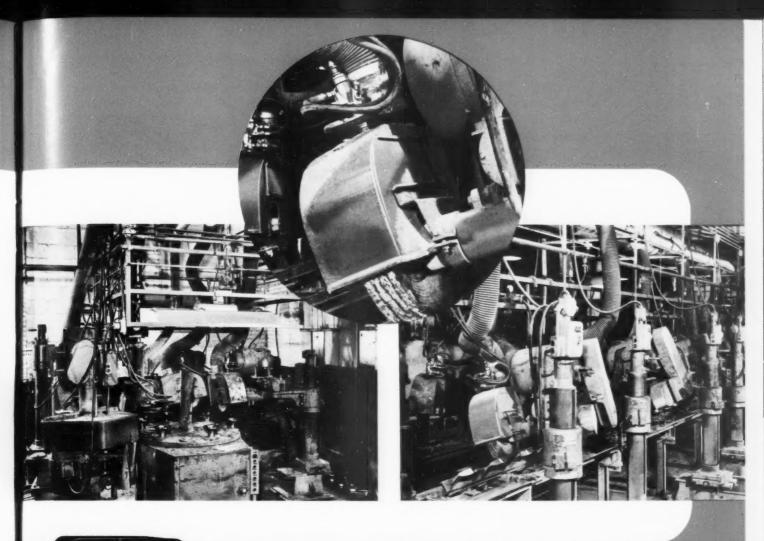
The master control sets and maintains uniform pressure -at every gun outlet. This unit is specially designed for exact metered control of Liquimatic Compound, when applied with Liquimatic equipment.

"Business end" of the Liquimatic System is the automatic spray gun. At all buffing stations, these guns deliver the liquid by means of a 3-way internal valve system that eliminates spitting and dripping. Each Economical heavy-duty Liquimatic pump



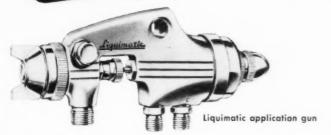
gun has its own adjustable pattern control, as well as an adjustable material needle valve to compensate for wear.

The electrical timer unit is an important additional feature of the Liquimatic System. It automatically controls the length of "on" and "off" repeating time cycles for each complete spray system. Still, the system is completely flexible because guns have individual variable controls. You can "trigger" each gun -make its time cycle longer than that set by the master control. You always get the exact amount of compound, pin-pointed to the needs of each buffing station, regardless of variations in demand.





Liquimatic electric timer unit

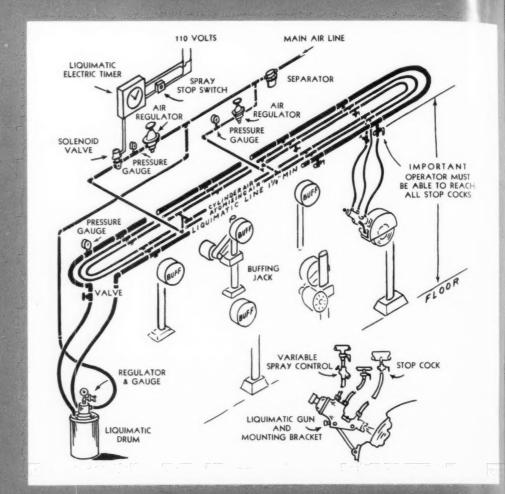


Liquimatic equipment is engineered to prevent line losses. Fluid pressure to each gun or bank of guns is equalized—automatically. The farthest gun gets the same pressure as the one nearest the tank.

Once installed, Liquimatic equipment operates with remarkable efficiency, and requires amazingly little attention. For the Liquimatic System is the result of years of research and development by top H-VW-M engineers. Exhaustive factory and field tests have proved its ability to step up production, insure uniform product quality and reduce downtime—effecting subtantial savings in time and material.

# Want to know <u>exactly</u> how much money you save when you go <u>Liquimatic</u>?

Get a free "Liquinalysis". An H-VW-M engineer can show you just how much time and money you can save your plant. He'll demonstrate the advantages of the Liquimatic System right in your buffing room. If you need a special formula, you'll see how simple it is to formulate one that will meet your viscosity or consistency needs. There's no obligation, and no interference with production schedules or your personnel . . . the test gear can be set up parallel to existing equipment. So, whether you use liquid or bar buffing compounds, be sure to see Liquimatic in action. H-VW-M offices are located in principal cities all over the country. There's one near you. Let us know your needs. Take advantage of this free offer now.



The diagram shows a normal multiple-head installation, as used in many of America's leading plants. Simple and neat, it is easily adapted to meet individual plant practice or job requirements

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<u>Liquimatic</u> InstallationADAPTABLE TO ALL TYPES OF EQUIPMENT

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ADVANTAGES



- Fast cutting—with cut tailored to your job
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ithout prior dumping of part of the olution. We do not see how this can e done automatically, since the mount to be discarded must be calulated.

Since the pH does not change rapidw, there is really no need for automatic chromic acid addition and, unless there are some local restrictions in connection with dumping a small amount of solution from time to time. an ion-exchanger does not appear to he warranted for such a small tank.

#### Cadmium and Zinc Deposits

Question: One of our associated companies is considering the expansion of its plating facilities in order to handle both the plating and chromating of moderate production quantities of chassis for radio and electronic equipment made from iron and sheet steel, and before they can arrive at a decision as to equipment and materials needed in this expansion program, they find it necessary to obtain some expert advice on the relative merits of "chromated zinc plating" versus "chromated cadmium plating," particularly insofar as the following questions are concerned:

1. Which is the more expensive overall process and by how much? Zinc plating + chromating or cadmium plating + chromating.

2. Since "solderability" is important in radio chassis work, which combination lends itself better to "ease of soldering"?

3. Since the chassis acts as a "ground" for certain electrical components, which combination produces the "minimum electrical resistances"?

4. Since corrosion of the chassis will alter "ground resistance values," which combination gives the most durable protection against corrosion?

Your advice and opinions on the above matter on an urgent basis will be greatly appreciated.

A. L.

Answer: Since cadmium anodes cost \$1.70 per lb. and zinc anodes cost 22c lb., while the former has a higher specific gravity, the metal cost per square foot of surface for an average deposit of about 0.0003" will be about 2½c, as against 1/1c. Aside from anode costs, all other finishing costs will be about the same for plain or chromated fin-

Cadmium is considered slightly better as respects solderability, but storage conditions prior to soldering are a more important factor.

Cadmium has a slightly lower electrical resistance than zinc.

Corrosion resistance will depend on the environment to which the finish is exposed. Cadmium appears to stand up better in salt-containing atmospheres, while zinc is more resistant to industrial atmospheres.

#### Discoloration of Silver

Question: I have been experiencing difficulties with hollow-ware and tea sets that have been silver plated in a bright silver solution. After a period of several months in stock, they develop a pink film on the inside only; the plating and color is very good on the outside, I would appreciate it if you could give me some information on this subject.

E. W. B.

Answer: The pink coloration which forms on silver plated surfaces is often due to decomposition of a film of silver salt to metallic silver. The outside of holloware does not show this condition because it receives better rinsing and the subsequent buffing operation removes any film of salts present. The interior is difficult to rinse completely, especially when the high concentration of the plating solution is

Wet scratch brushing the interior, followed by a thorough rinse, will often help in this case.

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### **ABSTRACTS**

#### Tank Materials for Pickling

E. R. Thews: Beiztechnik. Vol. 4, No. 10, p. 145.

Tank construction materials are considered for fine pickling practice, such as pretreatments prior to plating. For this purpose, wooden tanks can often be used only when lined either with organic or inorganic materials, or metal lined. Hydrofluoric acid and fluosilicic acid pickling solutions also attack wood. However, wooden tanks have many advantages, being inert to shock or impact, and there is a tendency to employ them more and more for treating auto parts such as cylinder blocks and castings, to remove burnt-on molding sand and casting skins. To reduce or prevent the effect of the hydrofluoric acid on the wood, recourse is made to sulfur impregnation. Cast tanks are also made from sulfur-sawdust mixtures or sulfur-carbon mixtures. These tanks are reinforced with angle iron.

The sulfur mixture tanks are relatively insensitive to all the pickling solutions in use. For strength, the wall thickness should not be less than 30 mm. The minimum bottom thickness is usually about 50 mm. (2"). If hydrofluoric acid pickling mixtures are not to be used, sulfur-sand mixtures can be use for producing cast tanks, the ratio of sulfur-sand used being 1:1.4.

#### Pickling Additions and Inhibitors

F. J. Heinrich: Beiztechnik. Vol. 4, No. 10, p. 146.

Tests are described which were conducted to ascertain the inhibitive action and pickling duration, influence of the addition agents on the pickling duration, and stability of the addition agents in the pickling bath, together with the influence of the iron content in the pickling acids on the iron attack and the pickling duration. A simple glass apparatus was used for the test, in which 5 sheet test pieces were simultaneously observed and the amount of hydrogen generated was measured. Sulfuric acid, 20% by

weight, was used as the pickling acid in the tests at 70°C. and 20% by weight hydrochloric acid at 40°C. The addition agents were added to the bath in amount of 0.2 to 0.5 g./l.

For the best bath additions there was found an inhibitive action in sulfuric acid of over 99% and in hydrochloric acid of about 95%. Tests which were conducted on the pickling duration, had the object of ascertaining to what degree the pickling time was prolonged. It was found that the "delay" factor was, in general, below about 1.5; i.e., with the varying inhibitors tested the pickling, in general, was not prolonged by more than about 50%. In sulfuric acid pickles, it is considered that a small content of ferrous sulfate has a favorable influence on the pickling speed, but higher iron contents reduce the speed.

Regarding the stability of the inhibitor additions in the pickling acid, tests showed that, for a 0.5 g./l. addition, there was no diminution in effectiveness in the acid, for some of the inhibitors. Other addition agents, however, which were initially effective, soon lost their protective action. Bath additions, on the other hand, which were only of moderate value, showed a great decline in their protective action. In a hydrochloric acid bath, the tendency towards a reduction of the effective action is frequently smaller than in a sulfuric acid bath. With good bath additions, the inhibitive action of the dissolved iron is not great.

#### Improved Pickling Techniques

I'Usine Nouvelle: No. 16 (1955).

A new pickling layout is described, the objects of which were threefold, to pickle the cast steel parts more rapidly, to reduce labor, only one man being required for the new plant, and to obtain parts with a clean and neutral surface. The most important objective of the plant was to improve the surface characteristics of the pickled parts, so that the castings which are machine parts for the food, textile, and chemical industries, are surface-free from sand, oxide inclusions and scale.

For pickling stainless steel castings, the following pickling bath was used: 3,150 liters of nitric acid, (68%) 173 liters of hydrofluoric acid, (60%), 123 liters of hydrochloric acid (30%) and 6,350 liters of water. The bath container was made of 6.5 mm.  $(\frac{1}{4}")$ 

thick steel sheet, lined with polyvin l chloride. The bath was heated by gas immersion burner.

For steel cast parts of low alloy can bon steel, the following pickling balls was used: 218 liters hydrochloric acid (30%), 145 liters sulfuric acid, 8 liters hydrofluoric acid (60%), water 1.800 liters. The bath worked at room temperature.

#### Influence of Structure and Thickness of Chromium **Deposits for Corrosion** Protection

M. P. Morisset: Paper read at the Annual Hard Chromium Conference. Paris (1955).

The author distinguishes two cases which are clearly separate: that of decorative chromium where the thickness of the deposit is of the order of 0.5 microns and that of hard chromium plate where the thickness is, in general, about 100 times greater, of the order of 50 microns.

With decorative chromium, the thickness of the deposit on nickel is limited to 0.2 or 0.5 microns because, in the neighborhood of greater thicknesses, towards 1 micron, it has been discerned that the protection was diminished. This has been attributed to the transmission of stresses and fissures of the chromium coating into the nickel undercoat, after a certain thickness is exceeded.

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For hard chromium plate where great thicknesses of chromium are deposited directly on steel, these phenomena are not observed. The author envisages successively, according to experimental results obtained, the influences of the state of the surface of the basis metal: different degrees of rectification, super-finishing, electropolishing; then the structure of the deposit, this latter depending on the conditions of the electrolysis—temperature of the bath, current density, composition of the plating bath. The author discussed a series of graphs explaining these influences under varied experimental conditions. In the particular applications where the qualities of protection against corrosion were specially studied and, if there is a limit in the thickness of the deposit, it is thus possible, by playing on these parameters, to improve the quality of the deposits. But, in practically all the classical applications, the thickness utilized to profit from the qualities of hardness of the chromium is such that it guarantees an excellent protection against corrosion.

#### Rectifiers in Plating Practice

M. Darmon: Paper read at the Annual Hard Chromium Conference, Paris (1955).

The author defined the structure of selenium rectifiers and discussed the essential characteristics of this equipment. The residual wave form has an influence on the deposit, as does the voltage and the automatic control. Factors influencing the service life are the overloading capacity, cooling, protection, maintenance. Finally, the output and the elasticity of employment govern the cost. For voltage regulation the author discussed the different procedures.

Regarding aging, the characteristics of a good rectifier are: Plates of a low initial resistance and above all, with known aging characteristics, a plate surface having, at full load, an acceptable current density, a super-dimensioned transformer and a super-dimensioned cooling system. The number of types of rectifiers for hard chromium plating, it is considered, should be limited to three; 500 amps., 1,000 amps., 2,000 amps. with continuous regulation from 3 to 10 volts.

#### New Surface Treatments for Aluminum

W. Linicus and P. Krekel: *Industrie Anzeiger*. Vol. 77, No. 72, p. 1041.

In the Granal process, aluminum parts are blasted with aluminum shot. With the Chem-Mill process (deep etching), unwanted parts of the metal are removed by etching. The action of boiling water forms Boehmite coatings on the aluminum which represent a modification of the aluminum oxide. The Alodine, Bonder, MBV and EW processes comprise chromating and phosphating. With the Impal process, anodizing is followed by a treatment with organic synthetics. A continuous process has been developed to anodize steel strip and sheet continuously, for food can packs. Wire is also treated in this way. Very hard, wear-resistant coatings of relatively great thickness (0.050 to 0.1 mm.) are produced by the hard anodizing process. Polishing processes are operated either chemically or electrolytically. German polishing processes are the Vaw-Erftwerk, Alupol IV, and the Schering process. Chromium plating of aluminum serves to increase the surface hardness and wear resistance.

#### Copper Plating Steel in Pyrophosphate Bath

N. Solowjow: Awtomobilni (Auto Industry — Russia). No. 8, p. 21 (1954).

The author gives details of the process of copper plating from the pyrophosphate bath, including the pretreatments and the secondary associated processes, the composition of the electrolyte, and the testing of the bath. Details are given of the formulation of the electrolytes and the tank lining. Drying of the coppered parts with sawdust in place of a drying oven is described. Details are also given of techniques of masking-off, by copper plating from the pyrophosphate bath, of steel parts for heat treatment. Tables of data are given, incorporating the main features of the process. The procedure of copper plating from the pyrophosphate bath is compared with other copper plating baths.

#### Black Oxide Coatings on Stainless Steel

Metallwarenindustrie und Galvanotechnik. Vol. 47, No. 2, p. 82.

The following process is given for the direct black coloration of stainless steel. The parts are polished in the normal way, degreased and then immersed in a 10% oxalic acid solution. The steel is fairly easily attacked by the oxalic acid. After some minutes, the parts are taken from the acid, and dried with a cloth. This drying with a cloth is important because the dissolved steel particles adhere as a fine powder to the surface. After this, the stainless steel parts are dipped in a 1% sodium sulfide solution. A black color is immediately formed on the surface. The parts must be well rinsed as otherwise spotting would result from the sulfide droplets. The surface is then dried with a soft cloth.

Another patented German process (DRP 594,962) employs a warm aqueous solution of sodium thiosulfate, sodium hydrosulfite, or the alkali salts of dithionic or polythionic acids, to which sulfur or hydrochloric acid has been added. Thus, 200 g. sodium thiosulfate are dissolved in 1 liter water,

and 50 cc. sulfuric acid are added shortly before use.

# SCIENCE FOR ELECTROPLATERS

(Continued from Page 67)

was attained at this plant by dividing the sodium hydroxide used for the anion exchange resin into three portions (a split elution technique). The same method was applied to the regeneration of the cation exchanger by splitting the sulfuric acid used into two portions.

The following theoretical quantities of chemicals used and sludge produced for these different processes are listed by the Metal-Finishing Industry Action Committee (Orsanco):

#### FERROUS SULFATE:

#### Chemicals

- 1 ppm. Cr requires 16.03 ppm. copperas (FeSO<sub>4</sub>·7H<sub>2</sub>O)
- 1 ppm. Cr requires 6.01 ppm. sulfuric acid (66°Bé)
- 1 ppm. Cr requires 9.48 ppm. lime (90%) for precipitation of both metallic sulfates.

#### Sludge

- $1\,$  ppm, copperas produces 0.38 ppm. Fe(OH)  $_3$
- 1 ppm. lime produces 1.84 ppm. CaSO<sub>4</sub> (not all sludge)
- 1 ppm. chromium produces 1.98 ppm. Cr(OH)<sub>3</sub>

#### SODIUM METABISULPHITE:

#### Chemicals

- 1 ppm. Cr requires 2.81 ppm. sodium metasulphite (97.5%)
- 1 ppm. Cr requires 1.52 ppm. sulfuric acid (66°Bé)
- 1 ppm. Cr. requires 2.38 ppm. lime (90%)

#### Sludge

- 1 ppm. lime produces 1.84 ppm. CaSO<sub>4</sub> (not all sludge)
- 1 ppm. chromium produces 1.98 ppm. Cr(OH)<sub>3</sub>

#### SULFUR DIOXIDE:

#### Chemicals

- 1 ppm. Cr requires 1.85 ppm. SO<sub>2</sub>
- 1 ppm. Cr requires 2.38 ppm. lime

#### Sludge

- 1 ppm. lime produces 1.84 ppm. CaSO<sub>4</sub> (not all sludge)
- 1 ppm. chromium produces 1.98 ppm. (Cr(OH)<sub>3</sub>

# Patents

RECENTLY GRANTED PATENTS IN THE METAL FINISHING FIELD



#### Bright Nickel

U. S. Patent 2,781,306. Feb. 12, 1957. H. Brown, assignor to The Udylite Research Corp.

A bath for electrodepositing ductile bright nickel plate comprising an aquecus acidic nickel solution consisting essentially of a material selected from the group consisting of nickel sulfate, nickel chloride, and a mixture of nickel sulfate and nickel chloride, having dissolved therein at least one compound selected from the group consisting of benzene sulfonamides and benzene sulfonimides in combination with an amount sufficient to enhance brightness of allyl urea.

#### **Bright Nickel**

U. S. Patent 2,781,305. Feb. 12, 1957. H. Brown, assignor to The Udylite Research Corp.

A bath for electrodepositing finegrained lustrous nickel comprising an aqueous acidic nickel solution consisting essentially of at least one material selected from the group consisting of nickel sulfate, nickel chloride and nickel fluoborate, having dissolved therein at least one brightener selected from the group consisting of organic sulfonamides, sulfonimides and sulfonic acids, and additionally a minor amount of another specified organic compound.

#### **Sheet Cleaning Machines**

U. S. Patent 2,781,535. Feb. 19, 1957. W. I. Phillips and J. C. Lawrence, assignors to C & H Supply Co.

A sheet cleaning machine comprising a tank, conveying means operable to move a sheet edgewise through said tank in succession through an initial washing station, a scrubbing station, a rinsing station, and a drying station.

#### **Bright Nickel**

U. S. Patent 2,782,152. Feb. 19, 1957. A. H. Du Rose and J. D. Little, assignors to The Harshaw Chemical Co.

A solution for electrodeposition of nickel in the form of bright and smooth deposits, said solution containing a nickel ion yielding compound of the class consisting of nickel sulfate, nickel chloride, nickel sulfamate and nickel fluoborate together with cooperating addition agents, as specified.

#### **Bright Nickel**

U. S. Patent 2,782,153. Feb. 19, 1957. A. H. Du Rose and L. D. Little, assignors to The Harshaw Chemical Co.

A solution for electrodeposition of nickel in the form of bright and smooth deposits, said solution containing a nickel ion yielding compound of the class consisting of nickel sulfate, nickel chloride, nickel sulfamate and nickel fluoborate together with cooperating addition agents, one of said addition agents being an organic sulfur compound, one thereof being selected from the class consisting of coumarin and its alkyl, acyl, chlorine and carboxy derivatives and a third thereof being a quaternary nitrogen compound.

#### **Corrosion Preventive**

U. S. Patent 2,781,314. Feb. 12, 1957. J. I. Wasson, assignor to Esso Research and Engineering Co.

An oil composition of improved rust preventive properties comprising a mineral lubricating oil, 1 to 6% by weight, based on the total composition, of sodium sulfonate and 0.05 to 0.15% by weight, based on the total composition, of finely divided substantially water- and oil-insoluble aluminum hydroxide having an average particle size of about 1 to 10 microns and capable of promoting and stabilizing a water-in-oil emulsion.

#### Corrosion Preventive

U. S. Patent 2,781,352. Feb. 12, 1957. M. De Groote and J. P. Cheng, assignors to Petrolite Corp.

A process for the preparation of a solvent-soluble cogeneric mixture containing cyclic amidines and cyclic amidine derivatives which comprises reacting a polyalkylene amine capable of forming cyclic amidines with a blown fatty oil at a temperature above amidification temperature and below pyroly. sis temperature of the mixture.

#### **Bright Nickel**

U. S. Patent 2,782,154. Feb. 19, 1957. A. H. Du Rose and J. D. Little, assignors to The Harshaw Chemical Co.

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A solution for electrodeposition of nickel in the form of bright and smooth deposits, said solution containing a nickel ion yielding compound of the class consisting of nickel sulfate, nickel chloride, nickel sulfamate and nickel fluoborate together with cooperating addition agents, one of said addition agents being an organic sulfur compound, one thereof being selected from the class consisting of coumarin and its alkyl, acyl, chlorine and carboxy derivatives and a third thereof being an alkylene amine.

#### **Bright Nickel**

U. S. Patent 2,782,155. Feb. 19, 1957. A. H. Du Rose and J. D. Little, assignors to The Harshaw Chemical Co.

A solution for electrodeposition of nickel in the form of bright and smooth deposits, said solution containing a nickel ion yielding compound of the class consisting of nickel sulfate, nickel chloride, nickel sulfamate and nickel fluoborate together with cooperating addition agents, one of said addition agents being an organic sulfur compound, one thereof being selected from the class consisting of coumarin and its alkyl, acyl, chlorine and carboxy derivatives and a third thereof being a polyalkylene glycol compound.

#### **Anode Structure**

U. S. Patent 2,782,159. Feb. 19, 1957. E. V. Berry.

An anode structure for chromium electroplating a cylindrical cathode surface of a crank pin as it rotates in a circular path in a vertical plane, which includes: two laterally spaced inverted substantially U-shaped sheets fabricated from an electrical insulating acid-resistant material, which sheets are formed with horizontal

lever edges on which said anode may be supported in an upright position when not in use; means for maintainsaid sheets including the lower portions thereof in a pre-determined laterally spaced relationship; a plurality of circumferentially spaced, transversely disposed shafts extending between said sheets; a plurality of rollers mounted on said shafts, said rollers adapted to rotatably contact said cylindrical surface and maintain said sheets at a fixed predetermined distance therefrom; a plurality of anode plates; electrical insulating means separating said plates; means for removably supporting said plates in fixed, circumferentially spaced, radially disposed positions between said side walls in sufficient quantity as to provide a desired area ratio between said anode and said surface; and electrical power supply means that supply substantially the same potential for each of said anode plates.

#### Degreasing Machine

U. S. Patent 24,281. Feb. 26, 1957. H. H. Jones and R. C. White, assignors to Robert C. White.

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Apparatus for treating work with a fluid, comprising a chamber adapted to contain a fluid and open at the top, a spiral conveyor extending into the chamber through the open top of the latter to a position below the fluid level in the chamber and having a vertical support, a work-carrying ramp mounted on the support and extending helically around the support from a position below the fluid level to a position above the chamber, means for depositing work on the ramp below the fluid level, means on the support above the open top of the chamber for moving the ramp vertically with a vibrating motion, and means also on the vertical support above the open top of the chamber for oscillating the ramp about its vertical axis during vibration of said ramp to advance the articles along the ramp.

#### **Electropolishing Apparatus**

U. S. Patent 2,782,160. Feb. 19, 1957. M. A. Treuhaft and C. E. Swanson, assignors to Hudson Electrochemical Co.

Apparatus for electro-polishing metal articles comprising a tank for holding electrically conductive filmforming liquid, a supporting frame extending above said tank, article-sup porting racks, means on each of said racks for supporting articles to be polished, means on said frame for supporting said racks for vertical movement within said tank, first drive means for reciprocating vertically said racks, a plurality of wiper carriers having vertically-extending juxtaposed leg portions, supporting means on said frame for supporting said wiper carriers for movement along a path adjacent said racks and so directed that juxtaposed leg portions of said wiper carriers pass on opposite sides of said racks, second drive means for moving said wiper carriers along said path, a plurality of spaced resilient wipers carried by each leg portion of said wiper carriers, said wipers extending inwardly so as to pass along opposite sides of said racks, and means for making electrical connection to said article-supporting means on each of said racks.

#### Aluminum Coated Ferrous Article

U. S. Patent 2,782,493. Feb. 26, 1957. J. B. Russell, assignor to Kaiser Aluminum & Chemical Corp.

A composite article comprising a base portion of ferrous metal coated with an aluminum base alloy consisting essentially of from about 1 to about 6% silicon and at least one element selected from the group consisting of boron, titanium, vanadium and zirconium in amount from about 0.02 to about 0.20% boron and titanium, and about 0.1 to 0.25% vanadium and zirconium, the total not exceeding about 0.5%, the balance substantially all aluminum and impurities in normal amounts.

#### **Abrasive Blast Machine**

U. S. Patent 2,782,564, Feb. 26, 1957. A. J. Liebman, assignor to Centriblast Corp.

An abrading machine in the form of a self-contained unit comprising a casing with side walls and a bottom having a laterally projecting enclosure at one side thereof providing an enclosed extension terminating in a window for the discharge of abrasive pellets against an object placed in front of the window against the extension, a centrifugal abrasive throwing wheel in the casing rotatable about a vertical axis at the level of the window, a means for driving the wheel, and a conveyor in the casing extending down from the wheel for gathering abrasive pellets.

#### **Compound Applicator**

U. S. Patent 2,782,575. Feb. 26, 1957. C. R. Housdorfer.

Apparatus as described comprising, an elongated stick holder having an open end and a transverse member at the opposite end, a rod mounted on and slidably passing freely through said transverse member, means mounted beyond said transverse member for longitudinally moving said rod at intervals in the direction of its length toward the open end of said holder, said rod being adapted to engage at one end against the inner end of a stick of buffing or polishing material in said holder and slidably bodily move said stick at its other end beyond the end of said holder, and releasable means associated with said rod bevond said transverse member for normally preventing longitudinal movement of the rod in the opposite direc-

#### **Rust Preventive Composition**

U. S. Patent 2,783,156. Feb. 26, 1957. J. D. Oathout and R. W. Scott, assignors to Esso Research and Engineering Co.

A rust inhibiting composition of the solvent and film-forming type which consists essentially of about 73-80 wt. percent of a volatile hydrocarbon solvent boiling within the range of about 250°-450°F., about 13-18 wt. percent of a non-volatile light hydrocarbon oil boiling within the range of about 500°-600°F., about 2-3 wt. percent of white crude scale wax melting within the range of about 121°-127°F., about 4-6 wt. percent of sorbitan mono-oleate and about 1-3 wt. percent of phenyl ethanol amine.

#### **Gas Plating**

U. S. Patent 2,783,164. Feb. 26, 1957. M. Hill, assignor to National Research Corp.

A method of producing an adherent molybdenum coating on a metal substrate capable of forming a diffusion bond with cobalt which comprises coating a thin layer of cobalt on the metal substrate and depositing on said cobalt layer a coating of molybdenum obtained by the hydrogen reduction of molybdenum chloride vapors.

#### **Plating Non-Conductors**

U. S. Patent 2,783,193, Feb. 26, 1957.T. Nieter, assignor to Motorola, Inc.A method for forming a metallic

coating on at least one surface of an insulating base which includes in sequence the steps of providing a flat strip member of an insulating material. punching at least one plug member at least partially out of said strip member and thereby forming a hole in said strip member, reinserting said plug member in the hole in said strip member with the surfaces of said plug member flush with the surfaces of said strip member, spraying a metallic compound solution and a reducing solution over at least one entire surface of the strip and of the supported plug member to form a continuous metallic coating over said strip member and said plug member, said plug member fitting tightly in the hole in said strip member so that the metallic coating does not cover the edges of said plug member or of the hole through said strip member, and subsequently removing said plug member from said strip mem-

#### **Chromate Conversion Coating**

U. S. Patent 2,784,122. March 5, 1957. N. Cox and G. R. Hoover, assignors to Armco Steel Corp.

A process of increasing the corrosion resistance of articles having surfaces of a material chosen from a class consisting of zinc, aluminum and alloys thereof, which comprises treating the clean surfaces of the said articles with a solution of chromic acid as the solute and water as the solvent, which water is substantially free of organic and inorganic acid radicals and in which the combined sulfate and chloride content does not exceed about 15 p. p. m., so as to form a film of the solution thereon. the concentration of the said solution being substantially 1/2% to 5%, and drying the said film, whereby to produce upon the surfaces of said articles a thin and substantially colorless rustresistant coating.

#### **Phosphate Conversion Coating**

U. S. Patent 2.784,124. March 5, 1957. H. R. Moore

A composition of matter consisting essentially of:

Secondary alkali phosphate, anhydrous, about 25.6 pounds to about 105.6 pounds.

Alkali nitrite, about 6.4 pounds to about 24.7 pounds, said nitrite combined with said phosphate in a ratio of 1 to 4.



Federated products:

Aluminum, Babbitts, Brass, Die Casting Metals, Fluxes, Lead and Lead Products, Magnesium, Plating Materials, Solders, Type Metals, Zinc Dust



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Competitive tests will show you that Federated brighteners do a better job . . . give you a blue-white sparkle that you cannot get with any other addition agents . . . provide a smooth, flawless undersurface for post-plating operations.

**CADMAX** for cyanide cadmium plating, is compatible with all organic brighteners, gives you brilliant results even from a new bath. No breaking-in is required.

**ZIMAX,** in powder or liquid form, is the most economical to use. It is applicable to every type of zinc plating operation; and is compatible with most other zinc brighteners.

**NIMAX** is a highly concentrated nickel brightener for use in barrel nickel plating. Five cents worth is enough for approximately 50 pounds of work. The deposit is ductile and extremely corrosion-resistant.

Each of these brighteners has undergone rigid competitive tests at ASARCO's Central Research Laboratory. Each performs better than any competitive product.

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AMERICAN SMELTING AND REFINING COMPANY

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In Canada: Federated Metals Canada, Ltd., Toronto and Montreal

#### Purifier for Copper & Silver Baths

U. S. Patent 2,783,194. Feb. 26, 1957. F. I. Nobel and B. D. Ostrow

An aqueous metal plating bath comprising an aqueous alkaline solution of a compound taken from the class consisting of copper cyanide and silver cyanide having incorporated therein an amount sufficient to oxidize sulfide sulfur in said bath of an alkali metal iodate.

#### Plating Method

U. S. Patent 2,784,151. March 5, 1957. P. J. Topelian, assignor to Tiarco Corp.

A method of electrodepositing metal from a bath having poor throwing power onto an electrically-conductive object having a multi-planar area comprising covering the multi-planar area with a porous,, electrically-conductive fabric, making the fabric-covered object the cathode in the bath, passing current between the object and an anode, and separating the fabric from the plated object.

#### **Chromium Bath**

U. S. Patent 2,784,153. March 5, 1957. A. H. DuRose, assignor to The Harshaw Chemical Co.

In a process of chromium plating from a solution comprising water, chromic acid, sulfate ion and a catalytic ion selected from the group consisting of acetate, fluosilicate and fluoborate ions, the method of reducing the quantity of anode sludge formation when electrolyzing said solution between a lead anode and a cathode to be coated comprising incorporating cobaltous ion in said solution in concentrations from about 0.4 to about 5.0 grams per liter.

#### Molten Salt Bath Cleaning

U. S. Patent 2,783,892. March 5, 1957. J. A. Faler, assignor to Kolene Corp.

An apparatus for cleaning metals by a molten salt bath comprising an elongated pot having a work zone wherein metals to be cleaned are dipped; a sludge chamber formed along one side and communicating into the pot and means to cause molten salt in the pot to pass through the length of the chamber for removal of sludge; and a row of sludge trays positioned within the chamber in end to end alignment and suspended from a rail secured at the top and extending the length of the chamber.

# Recent Developments

NEW METHODS, MATERIALS AND EQUIPMENT FOR THE METAL FINISHING INDUSTRIES



#### Portable Filter

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

Compact design of a new plating solution filter has been combined with an increased capacity of up to 900 gph free flow (or about 600 gph with carbon charge). Although it measures only  $15'' \times 15'' \times 28''$ , the portable filter has 3.5 sq. ft. of filter area provided by 16 Perspex plastic plates.

New filtering design features a solution entrance at the bottom of the unit and discharge at the top in order to effectively prevent the liquid from bypassing the filter. The special transparent casing of tough, stable thermoplastic permits thorough visual inspection of filtering action.

The Dincalux portable filter is designed for use in plating rooms as a general purpose unit. It may be used for intermittent or constant filtering or transfer pumping. The exclusive Perspex components resist alkalies, weak acids, and will withstand even limited quantities of organic brighteners.

A ½ HP single phase motor with a stainless steel shaft is housed in the base and is directly connected to a centrifugal pump. The pump is enclosed within the filter to eliminate the



need of separate pump casing. The filtering section is mounted on rubber gaskets between upper and lower housing plates.

A brass pressure gauge is mounted atop the filter housing to indicate when the efficiency of the filter is reduced to a point requiring cleaning. A built-in air chamber prevents the filtrate from coming in contact with the exposed parts of the gauge. Overall unit design permits ready disassembly for cleaning to save maintenance downtime.

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#### Preparation Processes for Plating

Enthone, Inc., Dept. MF, New Haven, Conn.

The Enbond "Z" process, for the treatment of zinc base diecastings, utilizes a carefully formulated and balanced anodic electrocleaner and a companion acidic activator to produce a uniformly active surface ready for standard copper plating operation. If precleaning is required for removal of large amounts of buffing compounds, the use of one of the manufacturer's standard emulsion cleaners can be incorporated into the cycle without further changes.

The cleaner and activator are both supplied as powders, thereby eliminating the constant handling of liquid acids. The activator has been designed for long life, which eliminates the frequent necessity of draining and refilling the dilute acid tank. Both the cleaner and the activator are so formulated as to be useful over a wide range of concentration, temperature and time, thus allowing the process to be used in existing manual or automatic cycles without change in speed unless desired for increased production or thickness of deposit, it is claimed.

The second process, called the Enbond "BR" process, is similar in nature to the "Z" process, but is intended for preparation of brass and other copper alloys for any type of electrodeposit. Both the cleaner and the activator are powdered products and their formulation is such that they

can be used satisfactorily for preparation of many steels also. Precleaning may be required when both copper and iron alloys are treated in the same baths. The cleaned and activated copper alloy surface is so uniformly active that maximum adhesion and brightness of the metal deposit is assured.

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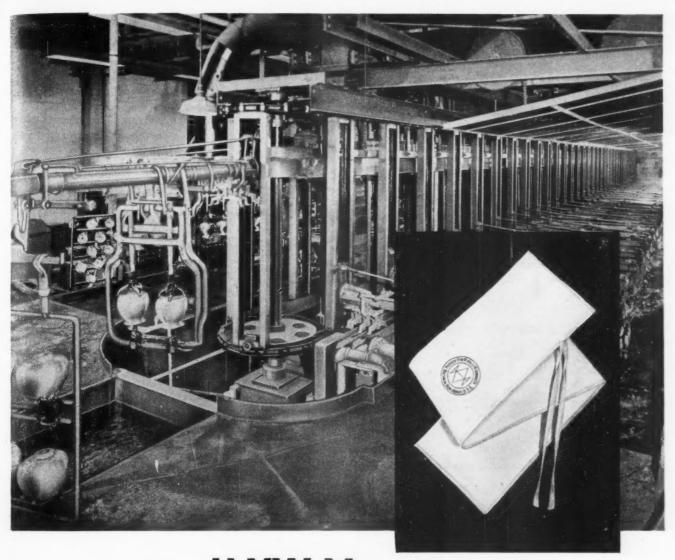
#### Steam Cleaners

Kelite Corp., Dept. MF, 81 Industrial Road, Berkeley Heights, N. J.



The above manufacturer has introduced a new three-model series of direct-fired steam cleaners. The Mark I, designed for light to medium duty, has an output of 120 gallons per hour. The Mark II, for medium to heavy duty, has a 200 gph output. The Mark III, with an output of 300 gph, is designed for maximum duty. The output of all three steam cleaners is rated at 320°F.

Each provides a positive displacement piston pump capable of delivering its full rated output hundreds of feet from the machine; an efficient waterwall heat exchanger to provide maximum fuel economy; and a gas or oil burner which provides instant starting. All three principal components



# WHY H-VW-M ANODE BAGS CAN CUT DOWN PLATING ROOM REJECTS

Everything that goes into the plating bath has some effect on the finished product. And, when you think about it, nothing can have a more direct effect on plating results than the bag that holds the anode. You may use the finest chemicals... the best anode stock. Yet the job can be ruined by harmful chemicals in the bag material, or made less efficient by a bag of inadequate design.

THAT'S WHY IT PAYS to get H-VW-M anode bags. They cost no more, yet each is designed like a fine tool . . . engineered to give top performance in specific plating operations. This fine

quality and precise engineering pays off in faster work, finer finishes—and fewer rejects.

Look for these features when you buy anode bags. You get them *all* with H-VW-M.

- Wide selection of materials.
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- No organic impurities of any kind.
- Minimum wear . . . longer life.
- Low, competitive price.

#### MADE ONLY OF LABORATORY-TESTED MATERIAL

You can be sure that every H-VW-M anode bag you buy is free from any matter which can prove harmful in the plating process. In modern H-VW-M laboratories, experts in plating chemistry constantly test anode bag materials under actual shop conditions. Only the purest pass these rigid tests. For diaphragm operation — H-VW-M can supply you with equipment to meet your needs. Write today for further information and prices.

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METAL FINISHING, September, 1957

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are ruggedly built for maximum service and minimum maintenance.

Standard equipment includes one heavy-duty steam cleaning gun with swivel-type rear grip and a forward grip aerated to provide cool operations; a Hy-Vel (high velocity) spray nozzle; and heavy duty hose. Optional equipment includes nozzle control for all gas-fired models; trailer or caster mounting for all oil-fired models; flat nozzle and flat nozzle kit; and extraheavy duty wire-braid hose.

Shipment is made F.O.B. Los Angeles, Cal.; Dallas, Texas; Chicago, Ill.; and Berkley Heights, N. J. In Canada, shipment is made through Kelite (Canada) Ltd., F.O.B. Vancouver, B. C., and Toronto, Ont.

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#### 1-Man Barrel-Lift

Morse Mfg. Co., Inc. Dept MF, 727 W. Manlius St., E. Syracuse, N. Y.

One operator safely and speedily performs five operations in handling loaded 55 gal. steel drums with this improved safety Barrel Lift — 1. Rais-



ing. 2. Transporting. 3. Rotating. 4. Tilting. 5. Draining. All operations are performed with no undue strain on the operator. The drum is under perfect control at all times. Self-locking safety stops prevent accidental movement of the handles. Tilt locks secure the drum in vertical position during transportation, and horizontally while contents are drained. The drum returns to vertical after draining. Patented features reduce spillage, overflowing, leakage, drum damage, and accidents. The unit

has adjustable leverage feature for various weight drums from 500 to 1000 pounds; floor clearances from 5½" to 11½"; is all-steel, welded construction with rigid steel tube base and structural tube supporting members; has rubber-tired wheels and ball bearing swivel rear caster. The lift is shipped knocked-down and is conveniently assembled.

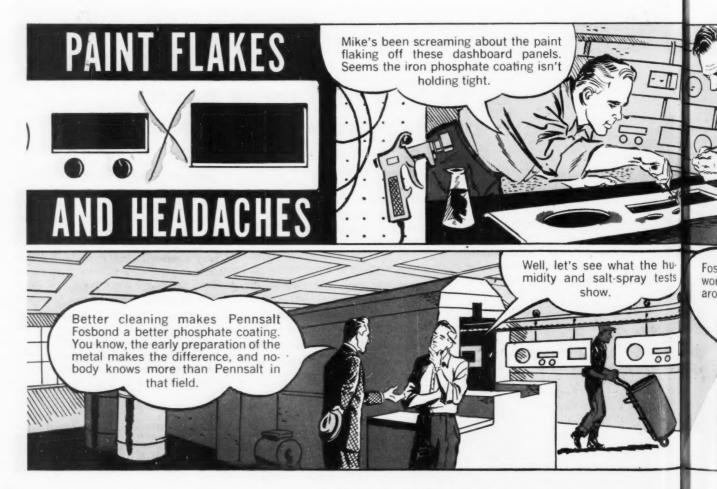
52/Circle on Readers' Service Card

#### **Solution Purifiers**

Precious Metals Div., Sel-Rex Corp., Dept. MF, Nutley, N. J.

The restoration of contaminated cyanide electroplating baths to full trouble-free production is now claimed to be possible through the use of Pur-A-Salts. This latest development consists of a patented formulation of barium double metal cyanides such as barium gold cyanide, barium silver cyanide, barium copper cyanide, or barium in combination with other cyanide electrolytes.

The salts remove carbonates, sulphates, and chromates through prefer-



ential precipitation, depending on the solubility of these impurities. The precipitation is effected on a molar basis—three ounces of Silver Pur-A-Salts will remove one ounce of sulphate or carbonates, and will supply about 1.35 ounces of metallic silver. Thus, not only is the free cyanide content of the bath undisturbed, but impurities are removed while other bath constituents are maintained at the desired ratios.

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53/Circle on Readers' Service Card

#### **All-Welded Plating Cylinders**

The G. S. Equipment Co., Dept. MF, 15585 Brookpark Rd., Cleveland, Ohio.

Model C and E all-welded cylinders for automatic oblique barrel plating machines feature rugged, heavy-ribbed hex design for better tumbling action, a marked advance over the more costly, conventional "round" cylinder. More thorough and rapid solution drainage is accomplished by a special hole (perforation) design providing more "open" area. Heavier danglers for longer wear are mounted inside as standard or outside as optional.

Both Tempron (hard rubber) and



"H-T Sincolite" cylinders are of the firm's exclusive heavy-ribbed all-welded construction for greater strength, longer service. Special yoke designs is claimed to hold cylinders more rigidly than conventional type. The Tempron cylinder operates in solution temperatures up to 250°F., air-dry temperatures up to 350°F. Both are available as complete assemblies, with yoke and danglers, to fit yoke arms of Model C

and E automatic barrel plating machines.

Prices: F.O.B. Cleveland. Tempron (Model C) as low as \$325; (Model E) \$425. "H-T Sincolite" (Model C) as low as \$225; (Model E) \$295.

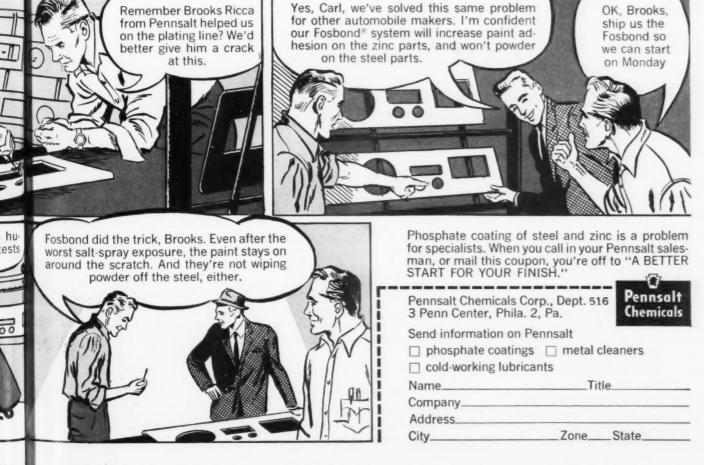
54/Circle on Readers' Service Card

#### **Chemical Stripping Compound**

Wagner Bros., Inc., Dept. MF, 418 Midland, Detroit 27, Mich,

A new organic material, when combined with sodium cyanide and dissolved in water, will strip plated deposits from ferrous-base metals without the use of electrical current. It removes copper, nickel, cadmium, zinc as well as silver, size of the part in no way hindering results, it is claimed.

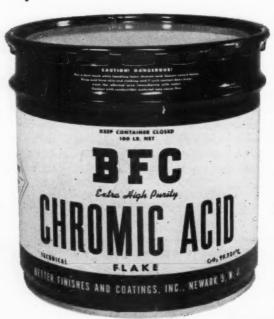
The compound, marketed under the trade name of Iso-Strip, has a higher first cost than conventional electrolytic sulphuric acid or sodium nitrate strippers. But its advantages far outweigh the cost differential. The manufacturer lists the following additional advantages for the development. It does not etch the basis metal; eliminates rack-





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#### BETTER FINISHES & COATINGS, INC.

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ing procedures, since parts may be stripped in baskets or tumbled in barrels; no supervision is required and the stripping can be done at night, parts being ready for production the next day; and the chemical can be used in a cold state by simply increasing immersion time.

The only equipment required is a plain still tank, draft box, coil and temperature regulator. Also tips of plating racks can be stripped, if of stainless steel or chromium plated. The only precautions prior to stripping are to make sure the work is free of grease or oil and, if parts are chromium plated, the chromium should be removed by an immersion in muriatic acid or caustic soda with reverse current.

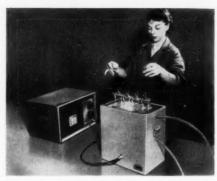
In stripping nickel at a temperature of 140°F., for example, the product removes 0.0005" of metal in 20 minutes. Other nonferrous metals are stripped at the rate of 0.001" in the same time, under identical conditions. Although the solution does not deteriorate while standing, it is consumed during stripping operations. The solution is not designed for operating temperatures above .150°F., since sodium cyanide decomposes faster with increases in temperatures.

57/Circle on Readers' Service Card

#### Ultrasonic Processing Tanks

General Ultrasonics Co., Dept. MF, 67 Mulberry St., Hartford 3, Conn.

Important features of these new 5-



and 8-gallon Sonitanks include extremely high ultrasonic efficiency operating at a resonant frequency of 20 kc/sec. A new method of attaching the reinforced transducer elements by riveting results in extreme ruggedness and greatly increased efficiency in the conversion of ultrasonic energy.

The large treatment chambers of the processing tanks are type 302 stainless steel with input and output drains to allow for recirculation and filtering of the liquid medium. Simplicity and economy of operation are important features of these new units.

The units were developed to fill a need for low cost, high intensity ultrasonic applications in cleaning, degreasing, pickling, and electroplating of metals.

The T-5 with a 5-gallon capacity, illustrated, operates with the (GU420) 400 watt 20 kc. ultrasonic generator. The T-8 with an 8-gallon capacity operates with the (GU720) 700 watt 20 kc. generator.

Custom units of smaller or larger volume are available to meet any specific requirements.

58/Circle on Readers' Service Card

#### **Electroless Gold**

Metal Processing Co., Inc., Dept. MF, 41 Canfield Road, Cedar Grove, N. J.

An electroless gold plating process, Lustralloy-G, has been developed primarily for use on electroless nickel. The gold deposition is continuous and deposits at a rate of about 0.0324g./ sq. in./hr. (0.0001"). On a polished nickel surface the gold is bright and adhesion is excellent. The deposit is quite tarnish-resistant and, for equivalent total plate thickness, preliminary tests indicate that salt spray results are equally as good as those of electrodeposited gold. While complete metallurgical data are not available now, the process is considered to be practical enough so that it can be applied where thin deposits of this metal are desired. Likewise, costs are comparable to those of electrodeposited gold, it is claimed.

59/Circle on Readers' Service Card

#### Aluminum Deoxidizer

Heatbath Corp., Dept. MF, Springfield 1, Mass.

"Deoxide" has just been introduced for desmutting, deoxidizing and removing heat scale from aluminum. It is used with water, 8 to 16 oz./gal. at room temperature. Time of treatment will vary from 30 seconds to 10 minutes, depending upon application. The material is furnished as a powdered product and is completely safe for use. It will not attack basis metal after smut, oxides or heat scale is removed, it is claimed.

60/Circle on Readers' Service Card

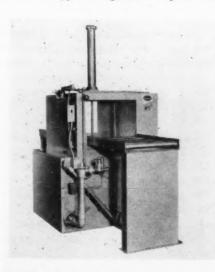
#### Parts Washer

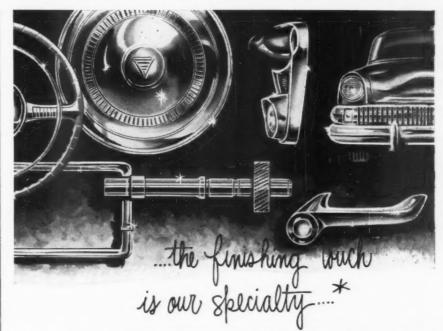
Eclipse Fuel Engineering Co., Dept. MF, Rockford, Ill.

A new washer is designed for removing oil from work before and after heat-treating or for general utility cleaning operations.

The new "Clean-Line" washer uses either hot caustic or detergent to remove oil, dirt, etc., and has a work area 24" wide, 36" long, and 18" high. Two basic models are available: (1) Double-end design that is loaded at the front and unloaded at the back, and (2) in-and-out type unit that is loaded and unloaded through the same opening. The hooded solution tank has a capacity of 300 gallons and is equipped with an overflow through and a drain valve.

A pneumatically operated work rack is used to lower work into the solution tank. Jet-type air agitation is provided





Are finishing methods a "trouble spot" in your operations? More and more cost conscious production men are turning to high-speed automatic polishing and buffing machines. You get faster, low cost polishing, buffing, deburring and more uniform results on a PACKER-MATIC, and you can also have the extra advantage of automatic loading and unloading. Long production runs, short odd-lot jobs, or a mixture of both can easily be handled. Send blueprints or sample parts and let Packer engineers show you how to speed up production and cut costs with PACKER-MATIC.



\*The finishing touch on automotive parts and accessories is just one of many successful PACKER-MATIC applications.

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THE PACKER MACHINE COMPANY . MERIDEN, CONN.

Pioneer Manufacturers of Automatic Polishing and Buffing Machines 61/Circle on Readers' Service Card

for the automatic washing operation. A timer is used to control the cycle and can be set to meet the needs of any particular process. The skimming operation is performed manually. A gas-fired atmospheric immersion burner, firing into a 5" heating tube is used to heat this solution. The burner is complete with a pilot and pilotstat and has an input of 175,000 btu per hour. Temperature of the solution is controlled by an immersion aquastat.

Roller loading and unloading platforms make the manual transfer of work on and off the work rack easy for the operator. The pneumatic cylinder for the work rack is supplied by an air line equipped with an air filter, pressure regulator, and oiler. Normal plant air is sufficient for cylinder operation.

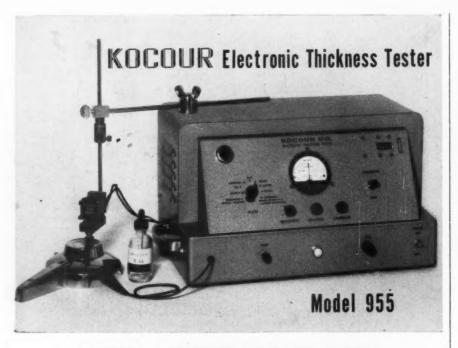
62/Circle on Readers' Service Card

#### Silicone Cleaning and Polishing Cloths

Edmund Scientific Co., Dept. MF, Barrington, N. J.

New non-woven rayon wiping and pelishing cloths are silicone treated to impart a protective, odorless, non-oily, non-greasy coating to highly finished glass, plastic and metals. Protection is furnished against fingerprints and the etching action of skin acids, dust, lint, mildly corrosive atmospheres and other deteriorating wastes such as grits and moisture.

Continued use imparts a water-re-



# HERE'S A POSITIVE WAY TO SOLVE PLATING THICKNESS PROBLEMS!

The accuracy of a thickness test can be no better than the accuracy of the method used. The Kocour Electronic Thickness Tester Model 955 gives you direct readings with an accuracy of 90-95%. A Calibration feature used in conjunction with accurately prepared Kocour Thickness Standards provides a check on this accuracy. In addition, a quick calibration adjustment automatically corrects slightly high or low readings.

Here is a positive method of thickness testing. A new basis on which both buyer and seller of plating can rely. Human error is virtually eliminated. Operation is quick, simple and automatic. Results are reproducible.

Model 955 may be the answer to your plating thickness problems . . . get full information today.

Ask for a demonstration or 15-day Free Trial!

# KOCOUR CO.

4802 S. ST. LOUIS AVENUE

CHICAGO 32, ILLINOIS

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pellant finish so smooth that future maintenance is greatly reduced. Sample 3-cloth package is \$1.00, 100-cloth packages for industrial use \$26.50 postpaid. Cloth size is 18" x 16". Lower prices on larger quantities.

64/Circle on Readers' Service Card

#### **Blast Cleaning Table**

Pangborn Corp., Dept. MF, Hagerstown, Md.

A small 4-ft. Rotoblast table room is now available for cleaning all types of work in foundries and plants that require a small, flexible machine for a wide range of cleaning operations. Castings, forgings and stampings up

to 48" diameter x 24" high, as well as plastic and composition materials, can be economically blasted in this low cost unit.

Capable of blasting loads weighing up to 4000 lbs., this new table is equipped with a cast labyrinth abrasive sealing system which makes the cabinet abrasive tight without rubber gaskets. For efficient loading, a single door opens to expose half of the 48 in. diameter rotating work table.

A single overhead Rotoblast wheel, powered by a 10 hp motor, will throw 15,000 lb. of abrasive per hour and for extra cleaning capacity, an optional 15 hp motor is available that will throw 22,000 lb. of abrasive per



hour. For maximum abrasive efficiency, a self-contained automatic elevator and separator continuously clean used abrasive for recirculation to the blast wheel.

65/Circle on Readers' Service Card

#### Acid Inhibitor

Enthone, Inc., Dept. MF, New Haven, Conn.

A new inhibitor for use in acid solutions, known as Acid Inhibitor II, is claimed to be superior to most others in that it can be used on high carbon steel without the dangers of etching. It is used at a very low concentration of about 0.2% by volume and can be added to cold or hot sulphuric or muriatic acids, or to other non-oxidizing acids such as phosphoric, hydrofluoric. oxalic, and citric acids. The material has no odor and does not produces a foam on the acid solution. Acid stable wetting agents may be added to the same solution when a foam is desirable.

66/Circle on Readers' Service Card

#### **Cold Solvent Emulsion Cleaner**

Octagon Process, Inc., Dept. MF, 28 Bank St., Staten Island 1, N. Y.

A new general purpose cold solvent emulsion metal cleaner is claimed to be rapid and highly effective for cleaning of both ferrous and non-ferrous metal parts at room temperature. Mighty-Mulse 563 is particularly effective on lubricating oil, grease, buffing compounds and general soil found in normal metal working operations. Oils, greases, etc., dissolve easily in the solution, and are emulsified when rinsed in water. Parts with slotted or tapped holes or with irregular openings or crevices are cleaned perfectly. it is stated. It is harmless to nose, throat or hands, will not jell, withstands heavy oil contamination, and has a pleasant odor.

Parts are left in tank from seconds of minutes depending upon the type of soil encountered. In many cases, it is the practice to leave a complete batch of parts in the tank until they are needed. After soaking, parts are rinsed in water, warm if possible, or pressure sprayed. They are then removed clean and ready for further work, repair or assembly.

The material has an exceptionally long service life and, if settled out solid particles are removed regularly, may be used for months.

67/Circle on Readers' Service Card

#### **Rust Preventive**

Heatbath Corp., Dept. MF, Spring-field 1. Mass.

Rustguard. for in-between rust proofing of ferrous metals, is a water soluble material containing a powerful rust inhibitor. It is mixed 1 to 20 parts with water and applied by immersion or spray at temperatures up to 212°F. It is used on ferrous metals to prevent rust after machining, stamping, drawing and forging; during assembly, storage and shipping; and as a final protective finish over conversion coatings such as black oxide and phosphates.

68/Circle on Readers' Service Card

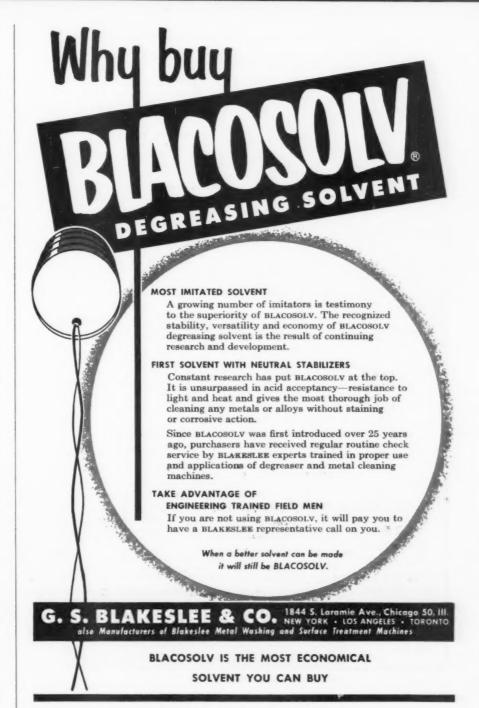
#### Bench-Model Ultrasonic Cleaning Generator

Branson Ultrasonic Corp., Dept. MF, 40 Brown House Rd., Stamford, Conn.

The Sonogen model AP-25-B was designed for use with the manufacturer's tank-type of all-welded stainless steel immersible transducers. It is ideal for unattended and quick cleaning of small parts. For cleaning-rinsing or other two-step operations, the generator output can be switched easily between transducers mounted in separate tanks.

Rated r-f output of the 10 x 16 x 12-





69/Circle on Readers' Service Card

in. deep generator is 125-watt average power, with peak power on pulses of 500 watt. It can also be used to drive up to three type B (bulkhead-mounted) immersible transducers, or one 125-watt type E transducer. These are all meant for mounting in the user's present cleaning tanks, or in tanks made to order.

70/Circle on Readers' Service Card

#### **Motor Overload Control**

Assembly Products, Inc., Dept. MF, Chesterland, O.

A new "fail-safe" overload control

is believed unusual in its combination of accuracy, continual indication of motor load, and adjustable load limits. Called the "Load Sentry," the new electro-mechanical control is built around the positive action of a contact meter-relay, and has no electron tubes. It is easily hooked into "start-stop" switches.

The maximum load to be permitted on the motor being monitored is set by an adjustable pointer anywhere on the dial of the meter-relay. The dial has 30 easily-read divisions, ranging from zero to 150 per cent of normal

### PIONEERS and LEADERS



#### in ELECTROLYTIC PRECIOUS METALS

Through the years, Davis-K has continued to lead the field in producing low cost solutions, time-saving procedures and revolutionary new electroplates. From Davis-K research laboratories have come two of the most outstanding developments in recent years.

ONE OPERATION

# First with Antique Gold Solution

An inexpensive, quality electroplate with excellent color consistency and remarkable

# First Again with HARD GOLD SOLUTION

FOR PRINTED CIRCUITS AND ELECTRONIC PARTS

Davis-K Hard Gold Plating Solution is an amazing new electroplate for the electronic industry which cuts gold deposit 50% while forming a lasting bond with either metals or plastics. Requires no elaborate set-up, has maximum resistance to high frequency, plates at low temperature and eliminates control problems.

#### OTHER DAVIS-K PRODUCTS

- \* POTASSIUM GOLD CYANIDE SALTS
- \* LUSTROUS WHITE RHODIUM SOLUTION

Now available: variable-type Tank Rheostats, specially designed for precious metal plating.

#### FREE Consultive Service!

As an added service, Davis-K process engineers are available for consultation concerning special plating problems and installations.

#### ALL DAVIS-K GOLD PLATING SOLUTIONS ARE:

- e made in all colors
- e color constant
- tarnish-resistant
- · brilliant in finish
- · bottled by Troy weight
- made from assayed US Treasury Gold only
- Ready for immediate

We are fully equipped to reclaim old gold and rhodium solutions. No charge for small sample plating. Write Dept. MFG-57 for details!

Where Glittering Elegance Reflects Lasting Quality.



. RODUCTS, CO. 135 West 29th St., New York 1, N. Y

t:Ongacre 4-1978-9

71/Circle on Readers' Service Card

load. Another pointer indicates the actual running load on the motor. When the pointers meet at an overload position, contacts lock and the circuit is broken. The device will then sound an alarm and/or shut down the sys-

Two special safety features are believed exclusive in its field. One is an interlock that keeps the circuit broken after an overload until the condition causing the trouble has been corrected and a manual reset button has been pressed to restart the motor. The circuit will not close otherwise even if the contacts of the meter-relay unlock for any reason, such as an external blow or bump.

The other distinctive safety feature is "fail-safe" circuitry. The load relay is energized when the control is operating, in contrast to the customary unenergized condition. Overload causes the relay to drop out and break the circuit through the motor. Similarly, any other abnormal condition, even

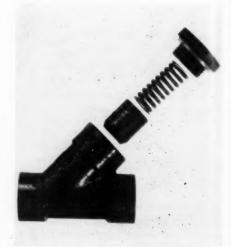


failure of parts within the control, will short out the load relay.

72/Circle on Readers' Service Card

#### All-Plastic Check Valve

Walworth Co., Dept. MF, 60 E. 42nd St., New York, N. Y.



Body and components of this new all plastic lift check valve are made of normal impact rigid polyvinyl chloride to provide high corrosion resistance to alkalies, acids, inorganic salt solutions and other corrosive flow material. A highly durable PVC spring positions the disc to assure quick and complete shutoff. The new check valve operates successfully at pressures up to 150 psi at 75°F.

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Light in weight the new check valve is easily handled and installed. It is available for pipe from ½ through 2 inches in size, and comes in either threaded, solvent-weld socket-type or flanged ends.

73/Circle on Readers' Service Card

#### **Tissue-Thin Industrial Glove**

Pioneer Rubber Co., Dept. MF, Willard, Ohio.

"Nimble Finger," a new industrial glove, is thinner than a surgeon's glove yet resistant to deterioration from corrosive substances and is comfortable to wear, according to the manufac-

Made of vinyl Pylox the gloves are designed for jobs requiring extreme finger sensitivity. This new model has unusually high non-allergenic properties making it ideal for most persons allergic to rubber gloves. They can be worn in comfort all day long thanks to the special textured inside finish. The new gloves can be turned inside out and worn reversed for jobs requiring a non-slip grip. The textured surface is perfect for such tasks.

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The material is resistant to normal acids, alkalis, oils, greases and some solvents. It is especially useful on jobs where the products being handled have to be protected from bacteria or per-



spiration. Available in small, medium and large sizes, the new gloves are  $10^{1}/_{2}$  inches long, offering ample wrist protection.

74/Circle on Readers' Service Card

#### Self-Filtering Ultrasonic Cleaner

Vibro-Ceramics Div., Gulton Industries, Inc., Dept. MF, 212 Durham Ave., Metuchen, N. J.

The Glennite U-102 circulating ultrasonic cleaner operates on a frequency of 40 to 44 kc, incorporates a forced air cooling system, and has a cleaning tank capacity of one gallon. Only sudless detergents or chlorinated solvents are required.

A circulating pump, permanent filter element, and an additional tank for recirculating the fluid eliminates the time - consuming task of manually draining the tank and filtering the dirty fluid to render it reusable. The circulator automatically begins operating at the conclusion of the predetermined cleaning period.

75/Circle on Readers' Service Card

#### Automatic Molten Salt Bath Descaler

Kolene Corp., Dept MF, 12890 Westwood Ave., Detroit 23, Mich.

A molten salt bath cleaning and descaling process, incorporating specially designed equipment, is now being used for aircraft parts reconditioning and overhaul. The process and equip-

QUARTZ IMMERSION HEATERS FAMOUS THROUGHOUT THE PLATING INDUSTRY For Quality, Efficiency, Low Cost Operations OVER 100,000 INSTALLATIONS For alkaline or acid heating jobs, you can depend on CLEPCO ELECTRIC IMMERSION HEATERS CLEPCO STEEL and STAINLESS HEATERS will meet all your specific needs. Low Heat Density - Long Life - Vapor-proof junction Box. SEND FOR COMPLETE INFORMATION THE CLEVELAND PROCESS COMPANY 1965 EAST 57TH STREET . CLEVELAND 3, OHIO

76/Circle on Readers' Service Card

ment can be engineered for either straight oxidizing or an electrolytic bath, and quickly removes scale, oxides, combustion deposits and other surface contaminates. A 100% metalurgically clean surface results, and

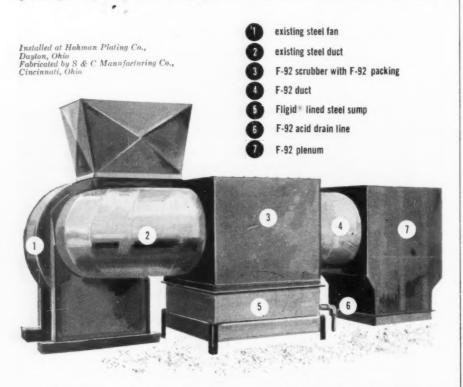


thoroughly cleaned parts are easily inspected prior to re-assembly in engines or other operating parts.

Scale and oxides are dissolved in the salt bath, or converted to an acid soluble form. The unit illustrated is an oxidizing salt bath installation. The powerful oxidizing members in the 900° molten bath will also completely degrease parts and can be used as an effective plastic stripper or paint remover. Parts to be cleaned are placed in baskets or on racks, which are fabricated of acid resistant alloy. The loads are conveyed by means of an overhead crane through the oxidizing salt, water quench, acid pickle tank, then are thoroughly rinsed. Provision

# new pvc scrubber recovers 98% of chromic acid eliminates corrosion

Because it is made of an outstanding structural material—VYFLEX F-92 Unplasticized P.V.C., this scrubber offers substantial advantages in design, operation, maintenance over conventional types. It is constructed throughout of Vyflex F-92—even to the bolts and nuts, as well as the scrubber packing, except for a metal sump, which is lined with Vyflex FLIGID Lining.



Design: The particular 10,000 cfm capacity scrubber shown is extremely compact... weighs only 600 lbs.... an 83% weight reduction. It is easily mounted wherever convenient... in one piece... on roofs or hung from ceilings without special supports.

Operation: Careful design and full use of the many advantageous properties of Vyflex F-92 Unplasticized P.V.C. contribute to the extremely high efficiency. Unit shown above scrubs chromic acid fumes at a rate of 10,000 cfm with only 10 gallons of water per minute and effects a 98 % recovery of expensive chromic acid. This complete scrubbing eliminates corrosion of fans and overcomes many of the problems of air-pollution with corrosive or offensive fumes.

 Maintenance: Since fumes are only in contact with VYFLEX F-92, scrubber corrosion becomes a thing of the past. And the hard, polished surface of Vyflex F-92 has greatly reduced liming—formerly a difficult maintenance problem.

VYFLEX F-92 Unplasticized P.V.C. was a logical choice as material of construction for these scrubbers, since its wide corrosion resistance range permits the use of this equipment in a broad line of chemical processing operations.

Other standard and custom designed equipment and parts of VYFLEX F-92 Unplasticized P.V.C. to solve your corrosion problems, are available from well equipped and highly experienced Kaykor fabricators across the country.

GET THE FACTS! Write for complete information in new Bulletin "F-92". Available free on request to Kaykor Industries, Inc., 4403 Broad Street, Yardville, New Jersey, or ask your local Kaykor fabricator.



#### KAYKOR INDUSTRIES INC.

Division of Kaye-Tex Manufacturing Corp.
YARDVILLE, NEW JERSEY

is made for an air blast to dry the parts. The overhead crane is supported by the unit itself, making it possible to install the unit in areas where overhead-supported rails would be a problem.

Design of the equipment varies with the size and number of parts to be cleaned. The operation is neat and clean. Thru-put of work per man hour is extremely high, whereas the amount of floor space used is very low. This is due to the rapid action of the salt on the contaminates to be removed from the surface of the metal. Further, any remaining oxides are rapidly and easily dissolved in the acid treatment.

Complete laboratory and demonstrating facilities are available at the manufacturer's plant,

78/Circle on Readers' Service Card

#### **Electric Heating Elements**

Cooley Electric Mfg. Corp., Dept. MF, 50 S. Shelby St., Indianapolis 7, Ind.

Thermoshells, electric heating elements for pipe, tube and tank heating, are an extended development of the above firm's embedded type electric furnace heating element, used successfully for over twenty years in industrial furnaces.

Furnished to heat to a temperature of 2,000°F., they can be used at lower temperatures, from room temperature on up. According to the manufacturer, heat is distributed uniformly over the entire area — no "hot spots" develop to produce isolated points of intense heat in the pipe. Installation is relatively simple and repairs can be made without serious delay.



All standard pipe sizes up to and including 12" are readily available, and larger sizes can be made in segmental form.

79/Circle on Readers' Service Card

#### **Abrasive Belt Grinder**

Abrasive Machinery Corp., Dept. MF, 444 S. Pennsylvania St., Indianapolis 4, Ind.

Fast operation with reduced operator

fatigue is offered in the Model 2-42 abrasive belt grinder. Designed for portable or fixed bench mounting, the unit will handle any grade grit of aluminum oxide or silicon carbide abrasive in 2 inch wide belts.

Used as a portable hand unit, the flexibility of the belt permits grinding of convex or flat surfaces. A belt support accessory may be attached quickly to give added rigidity to the belt on

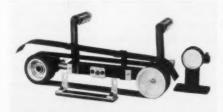
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flat grinding. The handles may be reversed for over or under the work grinding or for right or left hand operation. Six different handle adjustment combinations can be made.

The frame is cast aluminum alloy. The grinder is powered with a 1½ horsepower air motor which gives the belt a surface speed of 6000 feet per minute. The unit complete weighs 9 pounds 4 ounces.

80/Circle on Readers' Service Card

#### Safety Goggles

Sellstrom Mfg. Co., Dept. MF, Palatine, Ill.

Boasting features not previously found on flexible safety goggles, a new style of "soft sides" has been introduced with three different types of ventilation. According to the manufacturer, the design of these lightweight goggles makes them adjust to normal facial contours more successfully than other models on the market.

Constructed of tough, flexible vinyl with a cellulose acetate replaceable lens, the new goggle affords full impact protection and maximum vision. Having an extra wide frame, it easily fits over personal glasses and is said to be extremely comfortable to the wearer. An extra nose flange is said to provide a better fit and additional protection from flying objects Model 810 is the perforated ventilation style, while Model 811 offers screen ventilators and Model 812 has indirect air-vents.

A patented lens replacement is claimed to be an important improvement. Running completely around the frame





Tygon linings are really economical. Not necessarily from the standpoint of low first cost (which can be very misleading), but more important, they provide greater corrosion resistance — more positive protection, hence longer trouble-free service life. Tygon's outstanding resistance to oxidizing acids, alkalis, oils and greases make it suitable for jobs too tough for other lining materials to handle. Excellent dielectric properties guard against current loss. Nonoxidizing, flexible, and resilient, it resists aging, wear and abrasion.

Where solution visibility is important, Tygon white linings permit maximum visual quality control. Seamless, jointless Tygon linings are installed by a licensed Tygon applicator in your area, reducing delivery time and freight costs to a minimum.

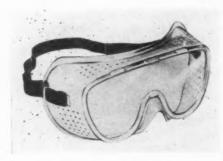
Tygon is the perfect membrane for oversheathing with USSCO acid brick. Built-in-place tanks, tank piers and foundations are lined at your plant to your specifications by trained field applicators. And our engineering service stands ready to help with all your lining problems.

257-E

Send for your copy of the fact packed, illustrated Tygon Lining Bulletin No. TL-526 PLASTICS AND SYNTHETICS DIVISION

# U. S. STONEWARE

82/Circle on Readers' Service Card



is a lens retaining channel. The lens itself has six opposing tabs to hold it within the channel during use; by flexing the frame at the tabs, the lens can be quickly removed or replaced. Lens and frame are supplied in clear or green plastic, or can be mixed as

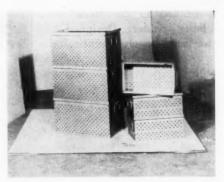
desired. This particular type of lens channel, incidently, is claimed to be more sanitary, keeping out dirt and grime from the job.

83/Circle on Readers' Service Card

#### Perforated Stackboxes and Stackbins

Stackbin Corp., Dept. MF, 1351 Main St., Pawtücket, R. I.

This processing container also serves as a container for vapor or liquid degreasing, quenching and similar dipping and cleaning operations, eliminating costly transfer of parts into special containers. Perforated stackboxes and stackbins can be used in conjunction



with like size stackracks and can be interstacked with regular stackboxes and stackbins of the same size. They are available in four sizes from 7½" wide, 13" long and 6" high to 15" wide, 19¼" long and 11" high. Perforations are on bottoms and sides; perforated ends are optional. The following size hole openings are standard in perforated stackboxes and stackbins: 7/32 inch and ½ inch holes on 1 inch centers and 7/32 inch and ½ inch holes on ½ inch centers staggered.

84/Circle on Readers' Service Card

#### **New Thermometer Series**

Wheelco Instruments Div., Barber-Colman Co., Dept. MF, Rockford, Ill.

A new thermometer series includes recorders, recorder-controllers, indicators and indicator-controllers.

The 4,000 series recorders and recorder-controllers use large 12 inch easy-to-read charts and represent industry's most advanced design in electronic instruments. Uniform accuracy over the entire scale is assured by the use of mercury-actuated sensing elements. These elements offer maximum stability over wide ranges of temperatures. Finely built Bourdon coils, friction-free pen arms and Invar metallic compensation for the instrument cases, makes the series outstanding in their smooth operation and dependable performance. Recorder-controllers (single pen) are available in a variety of control forms and use plug-in type control chassis.

Thermotrol temperature indicators and indicator-controllers incorporate all of the many fine construction features of the 4,000 Series. The attractively designed indicator scale is approximately 7½ inches long with black screened figures and graduations on a white background. The set point and controlled variable are both indicated.

Indicator - controllers use plug - in type chassis and are available in the same control forms as the round chart recorder-controllers.

The new instruments are available either as surface or flush mounted units. The overall dimensions are  $16\frac{3}{4}$  inches by 14 inches by  $8\frac{3}{8}$  inches. The temperature range of the series is from -40 to +950°F.

85/Circle on Readers' Service Card

#### Polyethylene Hopper

American Agile Corp., Dept. MF, 5461 Dunham Road, Maple Heights, Ohio.

A specially engineered polyethylene hopper can be used for filtering such corrosive slurries as hypochlorites, fluorides and caustics. The hopper, because it is constructed of polyethylene, is corrosion resistant, non-toxic, chemically inert, strong yet light in weight, and built for long, rugged service.

It is 42" high overall,  $24\frac{3}{4}$ " in diameter across the top, with conical sections 24" high. The 1" thick filter plate has  $\frac{1}{4}$ " holes on 1" centers. The portion above the cone is fabricated of  $\frac{1}{2}$ " thick polyethylene, while the cone itself is of  $\frac{1}{4}$ " polyethylene.

Of particular importance is that the cone position is fitted with a 131/2"



diameter flange for connection to existing equipment.

86/Circle on Readers' Service Card

#### Fire-Resistant Buffs

Schaffner Mfg. Co., Inc. Dept. MF, Schaffner Center, Emsworth, Pittsburgh 2, Pa.

The above manufacture announces

# **GOOD OPERATION**



# Cowles NS cleaner first... then barrel plating!

Our advertising agency looked in on this job plating shop with us one day and it didn't take a spyglass to find the Cowles NS drums. And it's no wonder, because this large plater\* has been ordering NS and other Cowles cleaners by the truckload for years. He says NS speeds his operation . . . cleans the tough jobs as well as the easy ones . . . eliminates rejects.

As an extra convenience to truckload customers, Cowles ships palletized drums if requested . . . 4 drums per pallet.

\*Metal Finishers, Inc., Cleveland, Ohio



#### CHEMICAL COMPANY

7014 Euclid Avenue

Cleveland 3. Ohio

87/Circle on Readers' Service Card

that full production is in process on the Fire Chief (Bias Type) aircooled, metal center buffs. These buffs are claimed to be positively fire-resistant and are produced by an entirely new process.

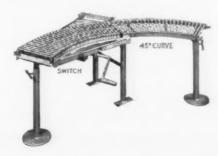
88/Circle on Readers' Service Card

#### Conveyor Switch

Metzgar Conveyor Co., Dept. MF, 499 Douglas St. N. W., Grand Rapids 4, Mich.

A midget version of the above manufacturer's gravity "Flex-A-Switch" for use with its "Mighty Midget" conveyors, is built in either wheel or roller type for quick adjustment from through travel to 45° right or left. (For 90° R. or L. a 45° curve is added).

The patented design provides positive travel at any angle without guide rails because axle centers are always on radial lines. Midget wheels and rollers are  $\frac{3}{4}$ " diameter and can be as close as 0.857" center to center. When closest centers are used, articles down to  $\frac{1}{2}$ " long can be handled satisfactorily.





89/Circle on Readers' Service Card

The switch is highly flexible in application and can be used in many combinations with curves and straight sections to distribute work in production, feed small parts assembly or inspection stations; gather and assemble orders and distribute finished work for stock piling. Standard switches are furnished with manual control, but can be supplied with either air or electric automatic control, remote or station operated.

90/Circle on Readers' Service Card

#### **Pocket Respirators**

American Optical Co., Safety Products Div., Dept. MF, Southbridge, Mass.

A new series of pocket respirators

incorporates improvements that contribute to efficiency and worker satisfaction in plants that use this type respirator, which has advantages for hot and humid conditions.

The units are practically indestructible, and offer multiple protection against many hazards. Made of corrosion resistant materials, they withstand corrosive atmospheric contaminants, washing in boiling soap solutions, or sterilization in autoclaves. The low-resistance inhalation valve gives ease of air intake, but protects the filter from exhaled air and moisture. Mouthpiece is easily replaceable, but withstands long wear. Construction prevents cartridge from touching or pressing against the wearer's chin.



Respirator body is of nylon; mouthpiece is soft vinyl plastic; nose clamp is flexible, tempered steel coated with vinyl plastic. Filter cartridges protect against airborne particles, vapors and gases, with several specialized types of filters available. Valves are leakproof.

The unit is compact, light in weight, and easy to carry on operations where workers are subject to occasional or accidental exposure to toxic matter.

91/Circle on Readers' Service Card

#### Temperature Regulators

Watts Regulator Co., Industrial Div., Dept. MF, Lawrence, Mass.



A new, accurate line of single seated temperature regulators for automatic flow regulation of liquids or steam, are self-operating and of two types, direct acting and reverse acting.

Direct acting regulators (155 Se-

ries) maintain the liquid temperature by controlling the heating source, such as steam. They are available in sizes 12" to 11/2" inclusive. Reverse acting regulators (157 Series) maintain the liquid temperature by controlling the cooling source, such as water. They are available in sizes 1/2" to 1" inclusive.

Both types are easily adjusted for temperature control within a 40°F. operating range within 100°F. and 240°F.

92/Circle on Readers' Service Card

# BUSINESS ITEMS

#### Erratum

On page 91 of our August issue we erroneously reported that Sid Mitwol of the Sel-Rex Detroit office had replaced S. S. Wilson as vice-president and general sales manager of the company. Mr. Wilson was recently transferred from Detroit to this new post at the home office in Nutley, N. J. Our apologies for any confusion which has resulted.

#### Krentel Promoted By MacDermid, Inc.

Stanley S. Krentel, vice-president of MacDermid Western, has been named executive vice-president of MacDermid Inc. He joined the company in 1945 as a technical sales representative for the firm's line of metal cleaning, plating and finishing products. In 1954, he was named vice president. Mr. Krentel will continue to reside in Franklin, Mich. and operate from the



Stanley S. Krentel



## NDY & HARMA SILVER ANODE:

Regardless of form, all Handy & Harman Silver Anodes are made of the same super-fine silver—silver fabricated by an exclusive production process that...maintains the highest standards of fineness...removes every trace of impurities detrimental to plating...assures consistent uniformity. These 999+FINE Anodes are turning out top-quality, trouble-free plating for thousands of manufacturers. They'll do the same for you. TRY them and see the difference.

#### A WORD ABOUT REFININGS

Send your silver plating solutions and other precious metal scrap, sweeps and waste to us for refining. Specially perfected scientific methods and equipment plus highly skilled technicians and long experience assure you of an accurate return from every lot. Send us your next shipment and let returns speak for themselves.



#### HANDY & HARMAN

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900 West Kinzie 31. 82 Fulton St. 44 West 44th Sr. Bridgeport 1 425 Richmond St. Chicago 22, III. Hew York 38, N. Y. New York 38, N. Y. (com. Providence 3, R. f.

93/Circle on Readers' Service Card

office and plant in Ferndale, Mich. He is a member of the Detroit Branch of the American Electroplaters' Society.

#### Allen Named Pioneer Representative in Southeast

The Pioneer Rubber Co. of Willard, Ohio, has announced the appointment of Charles M. Allen as its southeastern area representative for its Industrial Products Division.

A resident of Atlanta, Ga., Mr. Allen attended Emory University in that city, specializing in business administration. Before joining the Pioneer organization, he had been a sales representative in the southeastern states for Pendleton Tool Industries, Inc. Earlier in his career, Mr. Allen was a field



Charles M. Allen





Unit Process Assemblies, Inc., pioneers in non-destructive testing and specialists in electronics for metal finishing, offer their latest DERMITRON D-2 with these features:

- copper, zinc die-cast, aluminum, nickelsilver, bronze and other metals; also nickel on steel
- · Measures anodize and hard-coat on aluminum and magnesium; also paint, porcelain, organic coatings on non-ferrous metals.
- · Measures metal coatings on plastics, ceramics and other non-metallic materials.
- Sorts or matches metals and alloys,
- Measures plated coatings on steel, brass, Available with FOUR measuring probes for extra-wide thickness ranges from thin to thick deposits.
  - · Special probes can be provided for measuring on internal diameters, small diameters and otherwise inaccessible areas.
  - Only 1/4" circle area required for measurement.
  - · You get fast (within seconds), accurate, direct readings, plus versatility and portability.

Write for latest brochure and questionnaire to help solve your thickness testing problems.



## PROCESS ASSEMBLIES. INC

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engineer for Manning, Maxwell & Moore.

Mr. Allen's area of activity will include Alabama, Georgia, Florida, North Carolina, South Carolina, Tennessee, Virginia and part of Kentucky.

#### **Gates Engineering** Adopts New Trade-Mark

In order to achieve brand-name recognition of its complete line of Gaco neoprene protective coatings, Gates Engineering Co. of Wilmington, Del. is introducing a new company trademark

Originally designed as a label for the company's line of products, it has recently been incorporated on all company communications, including advertisements, letterheads, and technical reporting forms.

The label, featuring a large crimson lower-case "g" on a solid black background with the slogan "Gaco-the mark of corrosion protection" set in white, was recently selected as one of the six best labels of the year in the 7th Lithographic National Awards Competition sponsored by the Lithographers National Association.

#### **Grinding Wheel Industry Honors Irving Danielson**

Irving Danielson, vice president of Chicago Wheel and Mfg. Co., was recently honored for his sixty years of



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Irving Danielson

continuous service to the industry. Mr. Danielson was presented with a plaque from the Grinding Wheel Institute, whose membership is comprised of the major companies throughout the industry. Only one other such award has been previously made.

#### Allied Research Appoints Two

Charles W. Ostrander has been appointed technical director of Allied Research Products, Inc., Baltimore, Md. manufacturer of chromate conversion coatings and plating chemicals. In his new capacity, he is responsible for coordinating research development. technical service and manufacturing.

Raymond Stricklen has been named laboratory director in the development laboratory. In this capacity, he will direct all laboratory development projects as well as quality control operations relating to manufacturing processes and maintenance of industrial standards.

#### Changes at Enthone, Inc.

Enthone, Inc., New Haven, Conn., a subsidiary of American Smelting & Refining Co., advises several changes and additions to its staff.

J. F. Buckman, former executive vice president, and one of the original founders of Enthone, Inc., retired from active service on May 29. Edward F. Foley, Jr., formerly research chemist, has been appointed production manager and purchasing agent for the manufacturing facility at New Haven. Lawrence J. Durney, formerly research chemist, has been appointed manager of product development. Mr. Durney

will be responsible for the development of products for special problems constantly occurring in the metal finishing field. William K. Murray, technical service engineer with the firm since 1953, has been appointed manager of technical service.

Albert J. Kolb and Gordon G. Menzies, formerly senior lab. technicians at Pratt & Whitney, Div., United Aircraft Corp., have joined the technical service staff. As technical service chemists, they will handle customer service problems in the laboratory and at customer's plants. Miss Harriett Ciaburro has become control chemist in the technical service laboratory where she will analyze and control plating solution samples. John L. Morico, a graduate of Providence College and former biochemist with the U.S. Army Surgical Research Unit has joined the Development Department staff as development technician.

# Tamms Announces Change in New York Representation

D. B. Becker Co., Inc. has been retained by Tamms Industries Co., Chicago, to take over the marketing of their raw materials in the New York area, effective immediately.

A. C. Beier, who has ably represented Tamms in this territory for the past 25 years, retired on June first for a well-earned rest.

#### Wilgus Elected Electric Products Co. V.-P.

The board of directors of *The Electric Products Co.*, Cleveland 12, Ohio, has just elected *Harvey B. Wilgus* to



Harvey B. Wilgus

EVERY TONE A WINNER! Chrome Coloring Composition Spray Paster Stainless Stee and Tripoli Tripoli Emery Paste Grease Stick Burring COMPOSITIONS Representation in Major Cities Write Dep't. A for Samples 7he BUCKINGHAM PRODUCTS *Co.* 14100 FULLERTON AVE. . DETROIT 27, MICH.

the position of vice president in charge of sales. Mr. Wilgus has been general sales manager since joining the company September 19, 1955, and brings to his new position a wealth of selling experience.

Mr. Wilgus was formerly general sales manager of Redmond Co., Inc., Owosso, Mich. Before joining Redmond in 1943, he had been with Barth Stamping & Machine Works, Inc., Cleveland, Ohio; Hercules Powder Co., Wilmington, Del.; and the Pennsylvania R. R., Philadelphia. With these companies, Mr. Wilgus served as machine designer, sales engineer, district sales manager and division sales manager.

Membership affiliations include: So-

ciety of Automotive Engineers, American Ordnance Association and National Sales Executives Club. He attended Temple University, Philadelphia, Pa. and Kent State University, Kent, Ohio.

#### Cochrane Establishes Permanent Headquarters in Toronto

Cochrane Water Conditioning Limited, subsidiary of Cochrane Corp., Philadelphia, announces the establishment of permanent headquarters in its new building at 1355 Martin Grove Road, Toronto, Canada.

Here the company provides complete facilities for the sale, engineering design, manufacture and field service

### HIGHER LUSTRE IN BARREL TUMBLING FOR ZINC DIE CASTING

You can save as much as 90% in time in barrel processing zinc and aluminum die castings with specially developed PERMAG compounds

#### FOR BARREL COLORING-PERMAG #338

It will save you time and money. It takes only 45 minutes with but 1/3 of an ounce per gallon of PERMAG #338, to do a superior job on a barrel-load of zinc and aluminum die castings. For far better jobs, investigate the many advantages of PERMAG #338.

#### FOR BARREL DEBURRING -PERMAG #370

Satisfactory results in your deburring operations are possible with PERMAG #370, specifically developed for barrel deburring of all metallic parts. PERMAG #370 is efficient, economical and also useful as a rinsing agent.

Write today for samples and complete data on these and other PERMAG compounds, or for the assistance of PERMAG technicians on any tumbling or cleaning problems you may have.



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of its industrial water conditioning products.

The company also maintains offices in Montreal and Winnipeg and is represented in the Province of British Columbia by C. C. Moore and Co., Vancouver.

#### **Quelcor Appoints Francis**

P. T. Francis has been named sales manager of Quelcor, Inc., Chester, Pa.. manufacturer of PVC plastisols. Mr. Francis will coordinate the establishment of commercial applicators and the installation of in-plant systems in addition to heading the sales of the company's PVC products.

Before coming to the firm, Francis had been associated with the Gulf Oil Co. in an engineering capacity in Port Arthur, Texas, and Philadelphia, Pa. Prior to that, he had held sales assignments with Shell Oil Co. and Lee Tire and Rubber Co.

He holds a Bachelor of Science degree in Chemical Engineering from the University of Texas, He served with the U.S. Navy during World II, is married and has two children.

#### Graham, Savage Moves Main Office

The main office of Graham, Savage & Associates, Inc., consulting electrochemists and engineers, will be moved from the present Chicago address into new and improved quarters at 1724 Clinton St., Kalamazoo, Mich., (Telephone: Flreside 9-3726), effective September 1, 1957, according to an aunouncement.

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The move is part of a general reorganization of the corporation's activities, designed to improve the efficiency of operations and services to its clients. The main office and the Kalamazoo, Mich. office will be consolidated under the direct supervision of F. K. Savage. vice president. The corporation's pilot plant activities will be continued at the Kalamazoo location. Research, formerly conducted at the Chicago laboratory, will be moved to enlarged quarters at Jenkintown, Pa., and consolidated with the research activities regularly carried out at that location under Dr. A. K. Graham's direction.

#### Davis Resigns as Alcoa Chairman of the Board

Arthur Vining Davis, the only living American who has seen and participated in every chapter of the aluminum industry's history in the United States, has resigned as chairman of the board and as a director of Aluminum Company of America.

Mr. Davis, whose name has been indissolubly linked with one word aluminum - since he joined and helped establish Alcoa sixty-nine years ago, has been a director since 1892. and chairman since 1928. His decision

### BUFFS FOR INSIDE POLISHING



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stocked by many dealers throughout the country.

We manufacture a COMPLETE LINE OF BUFFS including full disc loose and sewed buffs and polishing wheels. Our meta' center BIAS TYPE BUFF may help cut your polishing costs.

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resign was prompted by "the pressires of other business interests, centering chiefly in Florida, that have prevented me from devoting the time and attention to Alcoa business affairs that I deem desirable and necessary."

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Shortly after World War II, Mr. Davis moved his residence from New York to Florida, and has since become deeply involved in many different business activities there. His resignation was accepted reluctantly at a special meeting of the company's board of directors on Friday, August 2, 1957. The board named Mr. Davis to the position of honorary chairman of the company, and passed a resolution expressing the management's deep and lasting gratitude to Mr. Davis for the immeasurable contributions he has made to the growth and success of the company, the entire aluminum industry, and the nation. No successor to Mr. Davis was named by the board.

#### Octagon Process, Inc. Appoints **New Minnesota Distributor**

Octagon Process, Inc., Staten Island. N. Y., has announced the appointment of the W. D. Forbes Co. of 129 Sixth Ave., Minneopolis, Minn., as their distributor in Minnesota.

Forbes is well known in the metal working and metal finishing industries, with intimate knowledge of metal cleaning, finishing and maintenance procedures. They will carry all of the Octagon specialty chemical lines. The more popular chemical specialties will be carried in stock, for immediate de-

#### Bristol's New Branch Factory, Repair Lab Opened in Houston

The accompanying photo shows the new branch factory and repair laboratory for Bristol Co. instruments, recently opened in Houston, Texas.

The new facility, at 3617 West Alabama, will be under the management of E. A. Merwin, district manager in the Houston area since 1945.

#### Murray-Way Represented By Eastern Distributor

Murray-Way Corp., Birmingham Mich., has appointed as distributor Giebel, Inc. of New York, and New Haven, Conn., according to an announcement.

This well-known Eastern distributing firm, headed by Robert L. Giebel, has been prominent in the machine tool field since 1932 and at present has eight salesmen covering Connecticut, Northern New Jersey and South-Eastern New York State, with offices at 250 W. 57th St., New York City, and 152 Temple St., New Haven, Conn.

Giebel's broad industrial background and long experience makes them an ideal representative for the manufacturer's line of flat polishing and automatic buffing equipment and specially engineered metal finishing systems.

# When Better Compositions Are Made, SPEEDIE Will Make Them!

With apologies to a certain automobile manufacturer, users of SPEEDIE Buffing and Polishing Compositions have learned to depend on The Buckeye Products Co. for the latest in buffing and polishing compounds. Bar or liquid tripoli or stainless steel — SPEEDIE friends rely on the experienced Buckeye laboratory technicians to come up with the answer to their toughest buff-

ing problems.

If you have a particularly difficult

buffing job, toss it to us. Prompt, direct and close cooperation between Sales, Engineering and Laboratory will solve your problems. Write us - today!

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## SOLVAY HYDROGEN PEROXIDE

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#### SOLVAY PROCESS DIVISION



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Greater throwing power, high ductility and easy control are features which distinguish Seymour Bright Nickel Solutions. Because they also eliminate buffing and polishing before chrome plating and are shipped in throwaway containers, they're tops with electroplaters everywhere.

Let Seymour help solve your plating problems in its Experimental Plating Laboratory. Write for details without obligation.

SEYMOUR

THE SEYMOUR MANUFACTURING CO. 4 FRANKLIN STREET, SEYMOUR, CONNECTICUT



#### 3M Opens New Cleveland **Branch Office-Warehouse**

Opening of a new branch office and warehouse in Cleveland, Ohio has been announced by Minnesota Mining & Mfg. Co.

The building, located at 12200 Brookpark Rd., has 70,000 square feet of floor space, about double the space in 3M's previous facilities at 12430 Elmwood Ave.

The branch office occupies about 20 per cent of the space in the new singlestory structure, which is of masonry and steel construction. Warehousing facilities occupy the remainder of the new building.

#### Parker Rust Proof Opens New Lab.

Parker Rust Proof Co. of Detroit, announces the opening of the nation's first automated "production line" laboratory for the treatment of metal surfaces. Developed at a cost of \$300,-000, the laboratory features two special machines which can make actual production tests in the use of chemical coatings for the prevention of corrosion, as a paint base and as aids in cold forming. Any problem pertaining to metal surface treatment can be handled at the unique installation at 2174 E. Milwaukee, Detroit.

At the new laboratory, a production sample can be treated at most any speed or condition that might be required in regular production. Stock in coils or sheets is fed into a completely automated machine which rapidly cleans the metal, rinses it, applies the necessary coatings by spray or roller method and dries the stock in a continuous operation. Completely flexible. this machine can simulate most any condition which might be encountered or required in an automated steel mill

Another new and modern installation is equipped to spray chemical coatings on test panels or production parts automatically. In addition to its customer service use, this equipment also mass produces standardized phosphate treated panels used by the paint industry for product testing purposes.

As an adjunct to solving coating problems, the facilities include complete equipment for making salt spray and humidity tests in new room sized chambers incorporating the latest developments in testing apparatus.

#### International Nickel Appoints Dr. May

The appointment of Dr. Thomas P. May as manager of the Kure Beach-Harbor Island Testing Station on the North Carolina coast near Wilmington has been announced by Internat onal Nickel Company's Research Division. Dr. May will transfer his headquarters from New York to the station, where research is conducted on the behavior of materials in salt water and sea air.

Dr. May had served since August, 1954, as technical manager of the station. Harry T. Paterson, who died May 27 last, was resident operational manager. Dr. May's position combines both technical and operational management of the station.

#### Corrosion Convention in London

Britain is to hold a National Anti-Corrosion Week from October 14 to 19 of this year. Principal features of this campaign will be a Corrosion Convention, to be held at Central Hall Westminster, London, on October 15 and 16, and a Corrosion Exhibition, at the Royal Horticultural Society's Old Hall, from the 15th to the 17th. A number of overseas delegates have already been registered for the convention, and it is hoped that many U. S. visitors will attend.

Papers by leading British experts will cover many aspects of corrosion. including: The Protection of Plant

or fabricating plant production line.

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over Lodg in he Oil and Chemical Industries; Corrosion in the Atomics Industry; Paints and Corrosion; Packaging and Corrosion; Metals and Alloys; Metal and Plastics Spraying and Finishing; High Polymers v. Corrosion; Cathodic Protection; Water Treatment; and Galvanized Coatings.

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Enquiries from intending delegates (the Convention is open to everyone interested either technically or commercially) should be addressed to the Organizer, Corrosion Convention, Stratford House, 9 Eden St., London N.W. 1. This campaign against industry's losses from corrosion is being supported by many British technical associations and engineering societies, and it is being organized by the Leonard Hill Technical Group.

# Whitehead Metal Executive Changes

Edward W. Lothman, vice president of Whitehead Metal Products Co., Inc., has been elected a director of the company. At the same time the company announced the election of Richard W. Nuffort as secretary, Frank A. Fink as treasurer and John W. Bonnet as administrative assistant to the president and assistant secretary.

The changes, all of which were effective July 1, were occasioned by 'he retirement on that date, under the company's retirement system, of Elmer W. Silver who has been with the organization for over 41 years. Mr. Silver is vice president, treasurer, a director and a member of the management committee.

Mr. Lothman, who continues as vice president, is succeeded by Mr. Nuffort as secretary. Messrs. Fink and Bonnet were named members of the management committee of the company.

#### The Bullard Clark Co. Elects Officers

At a recent meeting of the board of directors of The Bullard Clark Co. of Danielson, Conn., and Charlotte, N. C., Edward J. Bullard, former president and treasurer, was elected chairman of the board of directors of the ninety-year-old manufacturer of cotton buffing wheels. Mr. Bullard, who has been associated with the organization for over twenty-seven years, is succeeded as president and treasurer by Jack D. Lodge, formerly vice president and secretary of the corporation as well as





Jack D. Lodge

general manager of the Williamsville Buff Division, with which he has been affiliated for over a quarter century.

Other executive shifts include the promotion of *J. Edgar Moe*, general manager of Jacobs Rubber Division and former vice president, to the post of executive vice president and secretary of Bullard Clark. The post of

executive vice president was recently made vacant by the resignation of B. T. Clark who has retired after twenty-five years' service because of ill health. In addition to continuing as sales manager for the company's textile divisions, vice president William R. Muller was named division manager of E. H. Jacobs Northern Division.

#### Mexico Refractories Co. of Texas Pennsalt Distributor

Mexico Refractories Co. of Texas has been named distributor of Pennsalt Chemicals Corp.'s corrosion engineering products in Texas, southern Arkansas, and western Louisiana. Headed by general manager L. L. Brightman, the company's main office and warehouses are located at 2211 Walker Ave., Houston.

In addition to handling Pennsalt's extensive line of corrosion resistant mortars and protective coatings, Mexico Refractories will carry local stocks of companion products including acid resisting brick.

Experienced sales-service personnel

have been assigned to major industrial centers throughout the territory.

#### Promotions at Scranton For Trane Company

Two promotions have been announced at the Scranton plant of *The Trane Company*. George B. Littell, Jr., has been appointed superintendent, succeeding Richard Schiewetz, and Alexander S. Hair has been named general foreman. Schiewetz will head up the new Southern plant at Clarksville, Tennessee.

Littell, 29, has been with the firm since 1951. After three years in the plant engineering department, he became assistant to the superintendent, a position he held until his recent promotion. Mr. Hair has been with the Scranton plant since 1948.

#### Diamond Alkali Co. Promotes Four

Promotion of four employees to new administrative responsibilities at three silicate plants of *Diamond Alkali Co.* was announced recently.

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Work Holders Made from Spring Tempered Phosphor Bronze and Coated with Plastisol 100% Solid Insulation.

# 108 **5.95** each

#109 **5.75** each

# AMERICAN RACK CO. 8139 NORTH LAWNDALE AVENUE, SKOKIE, ILL.

George Brownewell, since 1952 enior engineer in the division's deelopment section at Painesville, Ohio ecomes process engineer at the Cininnati plant. He succeeds Frank Farlash, who is now technical assistant to the manager of the company's plant at Jersey City, N. J. Taking over new duties at the silicate plant at Dallas, Texas are Hanson Roberts and Billy J. Willer.

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Roberts, superintendent of the Dallas plant for the past 16 years, moves up to assistant plant manager. Miller, senior chemist there since 1954, becomes staff assistant.

#### **Gates Engineering Appoints** Ritterson Sales Engineer

Gates Engineering Co., Wilmington, Del., has announced the appointment of Harry S. Ritterson as sales engineer. Mr. Ritterson will represent the line of Gaco neoprene protective coatings and the steel fabricating services of Delaware Valley Steel Works, a Gates subsidiary.

Mr. Ritterson attended Drexel In-

stitute and Rutgers University. Before establishing his own business, he was general foreman of the DuPont Deepwater Works. In 1955, he sold his insulation contracting concern to Armstrong Cork Co. and became sales manager for the Kragor Corp.

#### Acheson Names Research and **Development Manager**

Arthur J. Stock has been appointed research and development manager for Acheson Colloids Co., Port Huron. Mich., a division of Acheson Industries, Inc. Mr. Stock replaces Dr. Harold J. Dawe who is now research director for the parent company.

Mr. Stock was formerly a research chemist with The Truscon Laboratories Division of Devoe & Raynolds Co., Detroit, and production manager for Henneberry Rotogravure Co., Chicago. Before joining Acheson he was project director for Chicopee Mfg. Corp., Springfield, Mass.

Mr. Stock received his B.S. in chemical engineering from Wayne University and did graduate work at the University of Michigan and Illinois Insti-



Arthur I. Stock

tute of Technology. He is a member of the American Institute of Chemical Engineers, the American Chemical Society and the Engineering Society of Western Massachusetts.

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 30-PT
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 Capacity (gols) 5
 15
 30
 55

 Height
 13½"
 20½"
 27"
 32½"

 Outside Dia.
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 14½"
 18"
 22½"

ness 1/16" 1/16" 3/32" 1/8" Price Euch \$7.50 \$16.50 \$21.75 \$24.00 LIGHTWEIGHT . LONG LASTING . NON-BREAKABLE



Cover Sizes and Prices Stock No. 5-PTC 15-PTC 30-PTC 55-PTC Size (gals) 5 15 30 55 Price Each \$3.50 \$4.00 \$4.50 \$6.00

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| Size's Ond Prices | Social No. | 11-PP | 14-PP | 17-PP | Copocity (sps.) | 11 | 14 | 17 | Height | 10's" | 11 | 11's" | Size Each | 53.00 | 33.50 | 54.00 | PLACE | YOUR | ORDER | TODAY! | Cover Price Size | Size No. | 11-PPC | Cover Prices | Size No. | 11-PPC | Cover Prices No. |

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1509 N. WASHINGTON KOKOMO, INDIANA

Barcelona, Spain announces that it is establishing in that country the correspondence course in electroplating offered by the *Joseph B. Kushner Electroplating School* of Stroudsburg, Pa. The Spanish Ministry of National Education has authorized the publication of the course as a valuable aid in modernizing Spanish finishing techniques.

#### Davis Retires After 54 Years With Cowles

Fred C. Davis, production manager, and manager of Cowles Chemical Co.'s Lockport, N. Y. plant is retired after more than 50 years of service. He will be succeeded by N. E. Woonton, recently elected vice president-manufacturing.

Mr. Davis started his career with the firm working during school vacations from 1903 to 1907, when he became regularly employed. In 1930 he succeeded his father, the late F. J. Davis, as superintendent and manager of the Lockport plant. The combined service of father and son has covered

the management of this plant from its opening in 1886 to the present time.

Robert H. Frank, superintendent, took over Mr. Davis' duties at the Lockport plant on June 1st.

#### West Coast Sales Representative Named by Engelberg

Lawrence Abbott has been appointed



Lawrence Abbott

West Coast sales engineer by Engelberg Huller Co., Syracuse, N. Y. manufaturers of abrasive belt machines.

Abbott's territory will include Washington, Oregon, California, Nevada, Idaho and Arizona. Previously, he was sales engineer for Darling Abrasive & Tool Co., San Francisco, and, most recently, for Mechanics Tool & Supply Company, Oakland. From 1937 to 1952 he was associated with the Cincinnati Milling Machine Co.; after completing a special four-year training program he was assigned the company's 11-state western territory as service representative.

Abbott majored in engineering at the Universities of California and Cincinnati, and the Ohio Mechanics Institute.

In his new capacity he will make his headquarters at the branch office, 2910 Sante Fe Ave., Los Angeles.

#### Heatbath Holds Sales Meeting

Heatbath Corp. recently conducted a three day sales meeting at the Moraine Hotel in Highland Park, Chicago,

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- ROLLED ELECTROLYTIC COPPER ANODES
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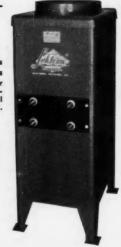
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Replacement Rectifier Stacks for Lektron or Udylite-Mallory

Magnesium copper sulphide rectifiers make your plating power supply more rugged and dependable. Magnesium radiator fins for fast heat dissipation and lighter weight. Matching pairs.



Model 4045—750 amps at 12 volts DC—1500 amps. at 6 volts D.C. Operates en 208, 220 er 448 A.C. Weight 525 lbs. F.O.B. Indianapelis, Indiana

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ELECTRONIC RECTIFIERS, INC.

2102 SPANN AVENUE

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INDIANAPOLIS 3, INDIANA



Back row, left to right: D. R. Barber, general manager; J. B. Wheeler, Indianapolis; E. A. Walen, Jr., vice president; R. Shepard, Chicago; G. P. Ott, Cleveland. Front row, left to right: B. Ifkovits, Chicago plant manager; M. A. Focht, Chicago; J. C. Drinkwater, Detroit; G. Nick, Chicago.

Ill., for its direct sales representatives from the midwestern area. Forums were held for the discussion of new products, advertising and sales campaigns. The representatives were also taken on a tour of the new and expanded manufacturing facilities at the Chicago plant.

#### Martin Joins Chemistry Staff of National Research Corp.

G. Lloyd Martin has joined National Research Corp. as assistant director of the Chemistry Department, where he will be responsible for inorganic chemistry and process development.

Dr. Martin brings with him an extensive technical background and long line of experience in the chemical field. He comes to the firm from Mallinckrodt Chemical Works, where he accumulated ten years of experience in analytical research, inorganic research and development, and as a research supervisor in its uranium division.

A graduate of Tarkio College (A. B. Chemistry) in Tarkio, Missouri, his hometown, Dr. Martin later received his Ph. D. in physical chemistry from Ohio State University, where he had previously been a graduate assistant and a research fellow.

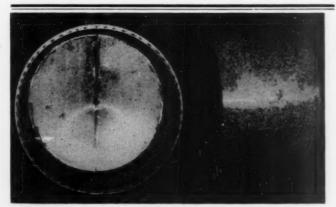
A member of The Society of the Sigma Xi, Dr. Martin is also active in the American Chemical Society, the Electrochemical Society and the Nuclear Engineering Division of the American Institute of Chemical Engineering Division of the American Institute of Chemical Engineers.

#### **Enthone Announces Personnel Changes**

Enthone, Inc., New Haven, Conn., a subsidiary of American Smelting & Refining Co., has announced the reassignment of some of its technical personnel as a part of the company's steady growth and expansion plans.

A. Robert Tefft, formerly active in the metal finishing industry of the Providence, R. I., area, and more recently technical service chemist in the Enthone laboratories, becomes resident service engineer in the Midwest. Mr. Tefft will supplement the service previously given by Robert Goodsell and will have his headquarters at the offices and laboratory of Ardco, Inc., Chicago, Ill.

Mr. Goodsell, formerly resident service engineer for the Midwest, becomes senior resident engineer of the same area. Mr. Goodsell will continue to have his headquarters at Ardco, and



#### They're a smooth pair - -

. . . stainless steel conical bottom tanks, welded by Storts, for a job that required absolute smoothness. No cracks, no crevices, no pinholes were allowable after the welds were ground and polished. The customer got a perfectly smooth finish without any special effort because Storts always welds stainless that way—and every other metal. Remember also that plating tanks and tank cycles have been a Storts specialty for nearly forty years.



38 Stone Street MERIDEN, CONN.

Manufacturers of Welded Fabrications to Specification

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his new duties will include supervision of Mr. Tefft.

A. Harry Sanders, sales and service engineer for Eastern and Northern Connecticut and the Springfield-Holyoke area, was appointed district manager for this same area. Mr. Sanders will continue to service his many customers and will be assisted by Frank A. Schneiders as sales and service engineer in the same area.

Mr. Schneiders was employed by Enthone from 1950 as technical service engineer in their laboratories. During 1954 and 1955, he served in the U. S. Army as chemical engineering assistant in the paint and chemical laboratory at Aberdeen, Md., on leave of absence. Mr. Schneiders is a graduate chemical engineer from Lehigh University, a Registered Professional Engineer in Connecticut and an active member of A.E.S. and A.C.S.

#### Sparkler Appoints Bader

Sparkler Mfg. Co., Mundelein, Ill., announces the appointment of George E. Bader as plant manager of the com-



George E. Bader

pany's heavy duty filter manufacturing operations in North Chicago, Ill.

Mr. Bader is a graduate in Mechanical Engineering from the Rolla School of Mines, Rolla, Mo. He is affiliated with the American Society of Tool Engineers, the American Society of Metals and the Industrial Management

Association. Mr. Bader was formerly vice president in charge of manufacturing and works manager of the Precision Scientific Co., Chicago.

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#### Appointments in Hooker Research and Development Department

Hooker Electrochemical Co., Niagara Falls, N. Y., is realigning its research and development staff in a continuing program of integration.

New research managers appointed are Dr. J. Howard Brown, in charge of phosphorus chemistry research, analytical and physical chemistry laboratories, and another laboratory now being planned; Morton S. Kirchner. in charge of inorganic and electrochemical research, and the Virgo laboratory, negotiations for licensing the Hooker cell, and research at the boron isotope plant in Model City which Hooker operates for the AEC: Dr. Jack S. Newcomer, in charge of organic chemical research which includes fluorine chemicals, agricultural chemicals, and organic synthesis.



The radial segment construction of the Zip-Tip Buff permits it to perform equally well on flat or contoured surfaces. The cross-cutting movement of the spoke-shaped segments prevent work streaking while it breaks up straight-line patterns on the surface.

- Zip-Tips are available in a wide variety of all cloth constructions
   —also combinations of cloth and sisal.
- Zip-Tips are made of heavyduty, bias-cut materials mounted on ventilated steel centers.
- Zip-Tips are extra thick and provide wider buff faces with greater compound retention capacity.
- Zip-Tips are perfectly balanced
   —require no raking.

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Self-Priming • Automatic Back-Washing

Models equipped with corrosive resistant alloys and materials for every electroplating and industrial solution from pH 0 to pH14. Also available all plastic filter pump with no metal contacts. Removes particles down to one micron in size.

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#### Harry Holland & Son to Represent Vanton Pump

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Vanton Pump & Equipment Corp., Hillside, N. J. has just announced the Inc., 9 South Clinton St., Chicago, Ill. to represent their line of plastic and stainless steel sealless pumps, pipe, fittings and valves.

The Holland organization has sold and serviced specialized equipment, including pumps, for over 20 years and will insure Vanton pump users and prospects, in the Chicago area, diligent and intelligent service.

#### Sel-Rex Names Kish Chief Engineer of Rectifier Division

The appointment of *Charles B. Kish* as chief engineer, Rectifier Division, has been announced by *Sel-Rex Corporation*, Nutley, N. J.

A graduate of M. I. T., with a Master's Degree in Electrical Engineering, Power Option Specialist, Kish has published several definitive articles on high voltage equipment. Prior to joining Sel-Rex in 1952, he had been plant



Charles B. Kish

utilities engineer with Inland Mfg. Div. of General Motors for five years.

In his new position, Mr. Kish will be responsible for much of the intricate circuitry design necessitated by the large power conversion units the firm has contracted to build for several electrochemical manufacturers.

## MacDermid, Inc., Names MacNeil V.P.

Arthur R. MacNeil, New England sales manager for MacDermid Inc., Waterbury, Conn., has been named vice-president of the company. Mr. MacNeil will continue as New England sales manager along with his new duties as vice president. He joined the firm in 1945 as a technical sales representative for the company's complete line of metal cleaning, plating and finishing products. In 1953 he was named New England sales manager. Mr. MacNeil has a broad background in all phases of metal finishing. He is past president of the Bridgeport Branch of the American Electroplaters' Society.

## Product Manager Appointed by Beckman

Appointment of Ray St. Onge as product manager for all instruments of the Process Instruments Division has been announced by Beckman Instruments, Inc.

St. Onge was formerly on the field



- RECTIFIERS
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   GERMANIUM
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No perforations—plates, needles, springs and small wire parts that catch in or slip through perforations in horizontal plating barrels.

Large barrel, 23" dia. by 23" deep; capacity, about 2 pecks. Made of heavy sheet steel lined with ¼" thick vulcanized rubber.

Tilting lever and foot-operated lock simplify loading, unloading and removal of solution.

Chrome plated button contacts bring current through bottom. Only contacts in the work carry current.

Anode basket to use scrap anodes. Saves time – avoids waste.

Send for literature or ask BELKE Service Engineer.



Heavy spring-operated contactors conduct current only to contacts in work.

MFG. CO., 947 N. Cicero Ave., Chicago 51, III.

EVERYTHING FOR PLATING PLANTS



Ray St. Onge

engineering staff, having the responsibility of the New York and Detroit areas. He received his degree in chemical engineering from the University of Detroit, and has been very active in the "Instruments Society of America", AIChE, TAPPI and Engineering Society of Detroit.

#### Thomas C. Wilson Joins Klem

Klem Chemicals, Inc., of Dearborn, Mich., has announced the appointment of Thomas C. Wilson as sales engineer in the Cleveland territory He will be located at the Cleveland office, 10-10 Euclid Bldg., Cleveland, Ohio.

Formerly with Nelson Chemicals and Ajem Laboratories, Inc., Mr. Wilson has had several years of experience in the industrial metal cleaning field.

#### New Engineering Firm Organized

A new engineering firm under the name of Consulting Associates has been organized to offer the industry combined services in all branches of engineering and chemistry, including plant design, testing, high polymer and coatings technology, economic and technical surveys, contract research, chemical processes, mechanical controls design, instrumentation, and formulation.

Recognizing the increasing shortage of scientific manpower, the compay

was organized to offer an unlimited source of technical talent especially to those who cannot employ full time scientists of specialized skills, *E. I. Arsan* is technical director of the firm, which is located at 1096 E. 64th St., Cleveland 3, Ohio.

#### 26th Exposition of Chemical Industries To Be Held in New York in December

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Announcement has been made that the Exposition of Chemical Industries will return to New York after an absence of six years, to be staged for the first time in the Coliseum during the week of December 2-6. The continued dynamic growth of the chemical process industries has resulted in some 500 exhibitors engaging space for displays that will occupy all four floors of the Coliseum.

With the chemical process industries representing a multi-billion dollar market now, and a still brighter future indicated, exhibiting firms are planning the greatest and most comprehensive array of chemical products and chemical process equipment since



TRUE BRITE CHEMICAL PRODUCTS CO.

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#### THE IDEAL ADHESIVE

For Setting Up or Recoating Polishing Wheels, Abrasive Belts & Discs

Nuglu, a liquid glue, developed to lengthen wheel life — produce a better finish, and increase metal finishing production.

#### **BRUSHING NUGLU**

A mixture of Nuglu and graded aluminum oxide grain —

Save on operating costs, increase production, reduce wheel inventories, and obtain greater results, with less costly materials, in fine polishing work!

Ask for information on The Siefen Finishing Systems

Also for better metal finishing use Siefen Compositions ● Stainless Steel ● Bar (Grease) in Tube ● Liquid Tripoli ● Liquid Grease ● Lapping Compound ● Burring Compound.

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1957\*

the exposition was established fortytwo years ago. For the convenience of visitors, there will be special sections for displays of chemicals and raw materials, as well as laboratory equipment and supplies.

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Reflecting the industry's constant search for new processes, more efficient techniques and improved product performance, the majority of exhibits will have as their theme "Increase production—Cut costs!" The 35-40,000 visitors anticipated will find the exposition a comprehensive post-graduate course in new developments and recent innovations in the industry. E. K. Stevens, president of the International Exposition Co., is manager of the Exposition.

#### Fischer & Porter Names Regional Managers

Fischer & Porter Co., manufacturer of complete process instrumentation systems, has named managers for its newly organized eastern, southeastern and southwestern sales regions.

Harold Russell has been named manager of the eastern region, comprising

the New York, Philadelphia, Boston, Baltimore-Washington, Richmond, and Albany-Syracuse offices. Mr. Russell was formerly sales engineer for major industrial accounts, working out of the New York office.

William Trethaway will manage the southeastern area, to include the Atlanta, Birmingham and Knoxville offices as well as the two offices in Florida at Clearwater and Jacksonville. Mr. Trethaway joined the company in 1951, serving in the engineering department before his initial sales appointment to the Atlanta office.

Glen Dorflinger has been given charge of the southwestern region which includes offices in El Paso, Dallas, Houston and New Orleans. Mr. Dorflinger was formerly manager of the Houston office.

#### Pangborn Appoints Petersen New Birmingham District Manager

Ralph A. Petersen has been appointed manager of the new Birmingham, Ala., district office of Pangborn Corporation. He recently joined the company as a sales engineer assigned



Ralph A. Petersen

to the home office in Hagerstown, Md., and now has the states of Alabama and Mississippi and Eastern Tennessee as his territory. The new district office is at 1731-C Valley Ave.

Petersen has previously been associated with Marion Machine Foundry and Supply Co. as chief industrial engineer and with the Lynchburg Foundry Co. as senior inustrial engineer.

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Used Cold. Non-flammable.

#### Non-injurious.

For speedy removal of tough industrial paints, enamels, synthetics, lacquers, varnishes, wrinkles, dye markings, graphite, metal lithography, epoxies, and enamel wire stripping.

- . Apply by DIP SPRAY or BRUSH.
- . WATER FLUSH or RAG WIPE.
- . REFINISH.

#### PHOENIX COLD STRIPPER

- ★ Will not affect precision parts of ferrous and non-ferrous metals, wood or glass.
- \* Non-corrosive, Non-evaporating, Non-toxic.
- ★ Does not lose strength through usage. Just add new stripper to replace drag-out.

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Write for SAMPLES and QUOTATIONS, or ORDER 5 GALLON AT DRUM PRICE.

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Largest Southwest sales and service representative for the country's leading producers of

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Manufacturers of plating racks . . . engineering service . . . coating service



DALLAS 1, TEX. 301 N. Market St. Riverside 7-5423

KANSAS CITY 8, MO. 813 W. 17th St. BAltimore 1-2128

An industrial engineering graduate of Georgia Tech, he is a member of the American Foundryman's Society and the American Institute of Industrial Engineers.

#### Minnesota Mining Elects Officers

Election of Joseph C. Duke as executive vice-president in charge of coated abrasives and adhesives and coatings and Bert S. Cross as executive vice-president in charge of graphic products has been announced by Minnesota Mining & Mfg. Co. Duke and Cross were recently elected directors of the company.

The company also announced the election of *Dr. Byron J. Oakes* as vice-president of the chemical products group, and *Cecil C. March* as vice-president of the coated abrasives and related products division.

Duke, who has been with 3M for 36 years, joined the company as a salesman. A vice-president since 1948, he has been responsible for the firm's coated abrasives and adhesives and coatings operations for the past two years.

Cross, who joined the firm in 1926 as a lab technician, has been responsible for all graphic products since 1953. He has been a vice-president since 1948.

Dr. Oakes has been general manager of the chemical products group since it was formed in April of 1955. He joined the company in 1928 as chief chemist, serving subsequently as manager for waterproof abrasives and general manager of the central manufacturing division.

March has been general manager of the coated abrasives and related products division since June, 1955. He joined the firm in 1933 as a laboratory technician. In 1948 March was named manufacturing manager for coated abrasives and related products.

#### Turco Names Richard W. Millar To Board of Directors

Appointment of Richard W. Millar to the board of directors of Turco

Products, Inc., Los Angeles manufacturer of industrial chemical processing compounds, has been announced recently. Formerly president of Bank-America Co., then the investment arm of Bank of America, Millar was, during the early 1930's, chairman of the executive committee of Douglas Aircraft Co. In 1938, he resigned from this position to become president of Vultee Aircraft, Inc. In 1942, he left Vultee to form Avion, Inc. with two associates. When this company was sold, he went to Northrop first as vice chairman and then chairman of the board.

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#### Wilson Rubber Co. to Expand

A three-year expansion program, calling for remodeling of present facilities and the addition of new equipment, has been launched by *The Wilson Rubber Co.*, of Canton, Ohio, manufacturer of rubber gloves.

This program, designed to bring the organization even greater recognition as one of the world's largest producers of rubber gloves, is the latest step in a program initiated after the firm was

# McKeon's Zinc-Britz

Top-quality, low-cost

# ZINC SOLUTION PURIFIER

Eliminates heavy metal impurities, including copper.

Prevents harmful build-up of carbonates.

A complete cleansing treatment: — No other purification measures necessary.

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Greensburg, Pa.

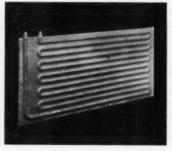
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One of the Dean Thermo-Panel Coil Standard Constructions. This one is TYPE AS. Applicable to Many Economical Uses in Metal Finishing.

Whether it is for heating or cooling solutions for metal washing, degreasing, plating, phosphating, etc., it is generally a mistake, today, to use old-fashioned pipe coils. The Dean Thermo-Panel Coil TAKES THE PLACE of pipe coils in a decidedly superior way. The first cost is usually less. Weighs less. Occupies less space. More easily replaced. Easily eleaned. More efficient and economical. Obtainable in special shapes — U's, L's and cylinders. Made of a wide range of metals — steel, all types of stainless steel, Monel, Inconel, Nickel, Carpenter 20, etc., and coated with zinc, lead, tin, chrome, copper and many others

For complete technical information ask for Bulletin 355 — 52 pages. For prices and design data ask for Bulletin 257.

BACKED BY 20 YEARS OF PANEL COIL MANUFACTURING

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DEAN THERMO-PANEL COIL DIVISION
DEAN PRODUCTS, INC. 613 Franklin Ave. BROOKLYN 38, N. Y.
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purchased by Becton, Dickinson and Co., Rutherford, N. J., surgical equipment manufacturer, in 1954.

#### New Representatives Assigned by Oakite

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Oakite Products, Inc., manufacturers of metal cleaning and treating materials, have announced the assignment of two technical service representatives.

J. Edouard Sauvé, who has represented the firm in Marion, Ohio, for the past five years, joins the Detroit staff and will serve the metal industries in the north-eastern metropolitan area. Peter J. Texier, Jr., since 1952 a member of the technical staff of the service laboratory, has been assigned to serve the metal industries in south Buffalo, N. Y.

#### **Armour and Co. Appoints Atkins**

Thomas Atkins has been appointed sales supervisor, Coated Abrasive Div., Armour and Co., Alliance, Ohio. He will supervise sales in Northern Illinois, selling both industrial coated abrasives and retail home products.

Mr. Atkins served in the U.S. Army Air Force as a First Lt. from September 1942, to October 1945, flying the "Hump" between India and China. He received his bachelor degree from Roosevelt University and attended Chicago public schools. Since graduating from college, he has been in various sales capacities.

## **Associations and Societies**

N. A. C. E.

#### Calgary, Alberta Section Is Sixth For Nace in Canada

A new section of the National Association of Corrosion Engineers has been organized at Calgary, Alberta Province, Canada. It is the sixth NACE local organization in the Dominion and the 53rd in the Association.

The National Association of Corrosion Engineers, a 5000-member organization, consists of individuals and companies interested in corrosion control methods, materials and processes.

#### Miami Section Plans **Technical Meeting, Short Course**

A program of technical papers and a corrosion control short course has been scheduled November 13-16, 1957 by Miami Section, N.A.C.E. The meeting will be held at Key Biscayne Hotel, Key Biscayne, Fla.

#### AMERICAN ELECTROPLATERS' SOCIETY

#### Saginaw Valley Branch

The Saginaw Valley Branch held its annual outing at Brookwood Gold Course in Flint on July 13, 1957, Two hundred and thirty-five members and guests enjoyed golf, softball, horseshoes, and good food.

Bay City walked off with the softball championship, and A. Muehlenback accepted the trophy. E. Graham



SEMICONDUCTOR APPLICATIONS

Co-deposits 24K Bright Gold and closely controlled percentages of Antimony, or other Group 3 or 5 elements, - developed specifically for Germanium and Silicon semiconductors. Bath operates at room temperatures and produces dense, fine grained, uniformly thick "Doped" Gold Plate precisely to your specifications. Write for technical data.

Precious Metals Division

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Manufacturers of Exclusive Precious Metals Processes, Metallic Power Rectifiers Airborne Power Equipment, Liquid Clarification Filters, Metal Finishing Equipment and Supplies.

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and E. Jarvis were ringer-conscious in winning the horse-shoe contest. M. Moore missed the puddles to win the blind bogey.

H. Pfeuffer won the door prize, a portable TV set, donated by Oakite Products. R. Durham won a set of irons contributed by Behr-Manning Co. Prizes were distributed to all after dinner

D. W. Synder did an excellent job in making this the conclusion of a successful 1956—1957 AES season.

P. A. Waskevich
Recording Secretary

#### Southwestern Branch

The third annual technical session will be held at the Dinkler Plaza Hotel in Atlanta, Ga. on February 14 and 15, 1958. Lectures will be held on both days, and the banquet is scheduled for Saturday night, February 15.

Howard Bone Chairman

# News from California



Don Bedwell, plant superintendent for Hallenscheid-McDonald Co. of Los Angeles, returned July 20 from a six weeks trip to the islands of the South Pacific, New Zealand and Australia.

Don reported making some interesting inspections of plating plants in Sydney, Australia, where officers of Sydney Branch, A. E. S., extended themselves to make the Bedwells welcome. In addition to enjoyable auto trips about the city and environs, Don was able to squeeze in visits to five plating plants in Sydney. The plant visitations were arranged, he reported, through the efforts of *Stuart A. Burmeister*, man-

ager of Robert Bryce & Co., representatives for the Harshaw Chemical Co. in Sydney, Victoria and other areas of Australia; and S. R. Bennett of Bryce & Co.'s Sidney technical staff, who served as the Bedwells' guide on their stay in the city.

Don gave METAL FINISHING brief descriptions of the plants he inspected in Sydney, as follows:

13

CO

Paul Roberts & Parsons, Pty, Ltd., Bourke Road, Waterloo. This is a manufacturer of dairy machinery and operates a small plating plant equipped to do nickel, zinc, copper, cadmium, and chromium plating. Foreman of the plating shop. *Jim Jones*, escorted them about. He is a member of Sydney Branch, A. E. S.

Pioneer Plating Works, Pty, Ltd., Ricketty Street, Mascot. This is a job plating operation owned by Leo, Harry and Ern Edwards. They maintain their own laboratory and keep their solutions well under control. Their operations include barrel cadmium, nickel.



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### SPEED-UP your nickel stripping PROTECT

STRIPODE

the base metal

A proved addition agent, STRIPODE strips nickel plate faster and protects the base metal from pitting, roughening and etching. Also saves on use of acid, eliminates need of sand blasting or heavy buffing operation. Try it!

ORDER A TRIAL GALLON!

THE CHEMICAL CORPORATION
54 Waltham Avenue

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# Zialite

Reg. U. S. Pat. Off.

#### for NICKEL PLATING

The one bath especially designed for plating DIRECTLY on ZINC, LEAD, ALUMINUM, BRASS, COPPER and IRON.

#### for HARD CHROMIUM

USE Zialite ADDITION AGENTS

Harder CRACK FREE deposits. Increased throwing power. Less sensitivity to sulfate content. Exceptionally fine results plating anything calling for Decorative or Hard Chrome.

ZIALITE CORPORATION

92 GROVE STREET

WORCESTER 5, MASS.

and chromium, barrel burnishing, cadnium, bright copper, bright nickel, and thromium plating.

Efco Manufacturing Co., Pty, Ltd., 108 Princess Highway, Arncliffe. The firm manufactures hardware. Managing director Reg nald Facer guided Bedwell about the premises . . . Bedwell reported that this firm has an extensive business in zinc base die-casting of hardware fittings, which they also electroplate. They are in the process of installing automatic equipment but, at present, are using hand loading methods. The plating section processes about 20,000 parts per day, with the nickel plating capacity being 4,000 gallons.

Austral Industrial Products Pty., Ltd., Fowler Street, Camperdown. Don discussed bright nickel installations with Managing Director Trevenna.

Sunbeam Corp., Troy Street, Campsie. This is a manufacturer of electrical appliances. *Tracey Bottomley* is plating superintendent. This firm, according to Bedwell, operates the largest plating plant in New South Wales.

second only to the General Motors Corp. of Australia. The Sunbeam plant is equipped with two automatic machines, one using copper, and one nickel and chromium. Total generating capacity is 63,000 amps. The automatic plating machine was made in Australia.

Don and Mrs. Bedwell were lavish in their praise of the welcome and cooperation extended by the Sydney plating fraternity. Although their arrival time made attendance at a Sydney Branch A. E. S. meeting impossible, Mrs. Inis B. Coulson, member of the branch's board of directors, was gracious enough to write the Bedwells a charming note expressing regret that the officers of the branch were unable to extend a personal and warmer welcome than circumstances made possible.

Other spots at which the Bedwells stopped on the tour included Auckland and Wellington, New Zealand, Samoa, Pago Pago, Tahiti, and Honolulu.

Technic, Inc. of Providence. R. I.,

has named the F. J. Marchuk Co. of Pasadena, Calif., as its representative in the states of California, Arizona, Oregon, New Mexico and Washington. The firm maintains headquarters at 261 East Colorado St., Pasadena.

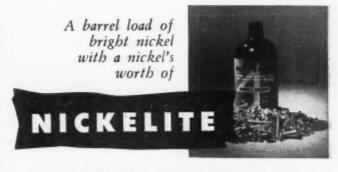
Crown Chemical & Engineering Co., Los Angeles plating equipment and chemical supply firm, reports the addition of a production department to its Los Angeles factory at 4722 Worth St. for the manufacture of a complete line of barrel finishing compounds. Laboratory facilities have been installed in which test runs of barrel compounds can be made while the plater-customer looks on.

According to Jack Bealle of the company, a complete line of tumbling media is being offered, including tumbling pebs, specially designed of white ceramic. Golden Latshaw, formerly manager of the barrel finishing department for the B. W. McIntyre Co., Reseda, Calif., has been named manager of the new tumbling compound division. He formerly operated the Hydromatic





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# CORROSION RESISTANCE UP 30% TO 100%

With Nickelite you can get 13 to 22 hours of salt spray exposure with 0.00006 inch of barrel nickel, instead of 11 to 13 hours. Actual salt spray tests show even greater improvement with thicker deposits. And you're saving money, too!

# WRITE FOR FREE FOLDER ON MODERN BARREL PROCESSES



Concentrated to quadruple strength — you don't ship, store or handle water! Shipping weight cut 275% — no deposits, no carboy returns. Stable, efficient, easily stored, easily used — a capful of Nickelite is enough for a barrel load of nickel.

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NEW YORK 3

Eugene M. Mills recently was appointed Southern District sales manager for Wildberg Bros. Smelting & Refining Co., Electronics and Industrial Division with headquarters in the firm's Los Angeles office, 635 S. Hill St. Mills has been connected with the precious metals industries in the aircraft and electronics fields in Southern California for several years.

Wildberg Bros. main office is at 742 Market St., San Francisco, and their plant is South San Francisco.

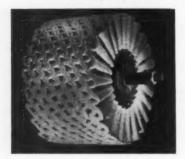
George Magurean, president of Los Angeles Branch, A. E. S., has announced the following appointments as committee chairmen: Phillip Simon of Barber-Webb Co., Los Angeles, as chairman for the annual educational session to be held in March, 1958; and Larry O'Neil of the Los Angeles sales engineering staff of the L'Hommedieu Co., as chairman of a committee to assemble and edit a handbook to be sponsored by Los Angeles Branch in advance of the 1960 Supreme Society Convention which will be held in Los Angeles.

Ground breaking ceremonies were held recently for a new administrative office building for American Pipe & Construction Co. of South Gate, Calif. The new \$350,000 structure will be erected at Atlantic Blvd. near Garvey Rd. in Monterey Park, Calif. The building will contain 25,000 square feet of floor area. For years the firm has operated administrative offices adjacent to its Southern California Division plant in South Gate. Plants are also operated in San Diego and Hayward, Calif., and Portland, Ore. Subsidiary companies are the Amercoat Corp., manufacturers of tank and pipe coatings, and Pipe Linings, Inc., both in the Los Angeles

O. W. Carrico was appointed general manager of the Automotive Division, Rheem Mfg. Co., Fullerton, Calif., effective on July 1. Operations manager of the division since 1954, Carrico succeeded F. G. Fisher, who has resigned. Carrico had preciously been division manager of the Houdaille-Hershey Corp., in Chicago. Rheems automotive facilities include a \$4.000 .-000 finishing installation comprising a fully automatic plating and polishing setup for use on bumpers and bumper parts. (Members of Los Angeles Branch, A. E. S., made a field tour of the plant as part of their June, 1957. monthly meeting.)

Brea Chemicals, Inc., operating in the petro-chemical field, and the R. T. Collier Corp., active in the carbon and allied fields, both subsidiaries of Union Oil Company of California, merged on July 1. The new corporation has been named Collier Carbon & Chemical Corp., with headquarters at 714 W. Olympic Blvd., Los Angeles. It will manufacture and market Brea Brand chemicals and will operate its petro-chemical and carbon business as corporate divisions.

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The carbon division has its main plant in Santa Clara, Calif., where industrial carbons for chemical and metallurgical processors are manufactured.

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Officers of the new corporation are R. T. Collier, chief executive officer; and Homer Reed, vice president.

A panel discussion on zinc, manned by members of the American Zinc Institute, featured a recent meeting of the Los Angeles Paint & Varnish Production Club held in Scully's Restaurant, Los Angeles.

Panel members were C. H. Adams, Sherwin Williams Co.; S. Werthan, New Jersey Zinc Co.; J. A. Reising, St. Joseph Lead Co.; and John Calbeck, American Zinc Oxide Sales. Mr. Reising acted as moderator. The panel clarified the function, need for, and use of zinc in certain paints for certain uses. The low toxicity, ultra-violet resistance, and mildew resistance of paint films containing zinc oxide were a few of the advantages cited as being derived from this product.

The panel agreed that it is possible to formulate for a given locality for a given property without zinc but, with zinc, one may formulate for good performance in all properties at all locations. Zinc, the panel stated, produces a factor of safety and has a long history to prove its worth.

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The Third Western Plant Maintenance & Engineering Show held recently in San Francisco attracted an attendance of 7,000 to the exhibits and 500 to each of eight technical sessions at which the rising costs of keeping western plants in competitive operating conditon was the principal subject of discussion.

The show was held in the San Francisco Civic Auditorium. Products of 101 exhibitors were on display, including such well known firms in the plating supply field as Turco Products, Oakite, Inc., Clementine, Ltd., and others.

Displayed were the latest developments in plant equipment and materials, geared specifically to the needs of industry in the West. The equipment on exhibit ranged from building materials, electrical equipment and safety items, to heating and ventilating units, finishing equipment, and materials handling facilities.

#### OBITUARIES

6

3

#### KERSHAW HARMS

Kershaw Harms, vice president of American Smelting and Refining Co., died suddenly on Friday, July 12, 1957. His age was 58.

An ASARCO employee for 40 years, Mr. Harms served the company in many capacities, including 14 years as manager of its Perth Amboy, N. J., plant. Since 1954, he had been general manager of the Federated Metals Division, being made vice president in charge of the division in April of this year.

Active in community affairs, he was a vice president of the New Jersey State Chamber of Commerce, and a past president of the Perth Amboy Industrial Association. He served as a town councilman in Westfield, N. J., where he made his home.

Mr. Harms is survived by his wife, Florence, and his two sons, James H. and Thomas K.

#### WALTER C. KERRIGAN

Walter C. Kerrigan, assistant to the president of The International Nickel Co. of Canada, Ltd., and its United States subsidiary, The International

Nickel Company, Inc., died Tuesday, July 16 at the Middlesex General Hospital, New Brunswick, N. J., after an illness of several months. He was in his 65th year. Mr. Kerrigan resided at Woods Lane, Colonia, N. J.

Mr. Kerrigan joined the Nickel Sales Department of Inco in January, 1930, giving special attention to copper, the platinum metals, gold, silver, selenium and tellurium. In January, 1933, he was appointed assistant manager of the department and, in June, 1946, became manager. He was elected vice-president of the company in December, 1947, and vice-president and general sales manager in May, 1952, and has served as assistant to the president of that company and the parent company since May, 1954.

Prior to his association with International Nickel, Mr. Kerrigan had been vice-president and sales manager of the French-owned United States Nickel Co., in New Brunswick, N. J., at

the time its European owners put the company into liquidation in 1929. During World War I he served with the United States Navy from 1917 to 1919, previous to which he had been secretary to R. L. Hoguet, who was vice-president and counsel for the United States Nickel Co.

Mr. Kerrigan attended Rutgers University and Columbia University. He was a member of the American Institute of Mining and Metallurgical Engineers, the Mining Club, New York, City Midday Club, New York, and the Colonia Club, Colonia, N. J.

Born in Brooklyn, New York, on October 21, 1892, Mr. Kerrigan was the son of the late Daniel and Margaret Fitzgerald Kerrigan. He is survived by his wife, the former Edna E. Bower; a daughter, Mrs. Joseph J. Cahill, Jr.; two brothers, Daniel Kerrigan of Palenville, New York, and John Kerrigan, of Calumet City, Illinois, and two grandchildren.

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1500	30/50	Century
1500	40/65	G. E.
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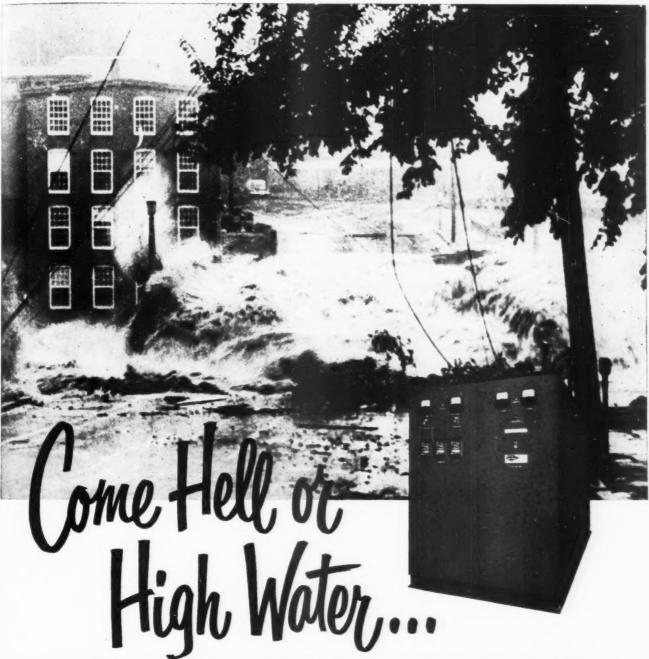
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